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Facility Information for:

U.S. Army Tactical Vehicle Organizational and Support Maintenance

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| 20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This document provides a comprehensive set of planning concepts pertinent to tactical vehicle maintenance construction projects. These concepts are applicable to all generic functions associated with both Organizational and Direct Support maintenance for most Army vehicles. The categories of information contained in this document relate Army policies to the activities, personnel, and equipment required to accomplish a specific function. The information in this document has been integrated into a four-page format, so that | | |

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all information related to a particular function can be viewed together. Eight types of information are provided: function, policy, issues, assumptions, activities/personnel/equipment, requirements, criteria, and guidance. The document was organized in this manner to permit ready incorporation of applicable information into appropriate Design Guides, Technical Manuals, and standardized design criteria.

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FOREWORD

This report contains facility pollution abatement information that has been developed at the U.S. Army Construction Engineering Research Laboratory (CERL) under Project 4A762731AT41-D-041, "Military Facilities Engineering Technology"; and Project 4A762720A896, "Environmental Quality for Construction and Operation of Military Facilities"; Task T2, "Pollution Control Technology"; Work Unit 027, "Functional Requirements for Consolidated Maintenance Facilities for Tactical Vehicles."

The work was performed by the Energy and Habitability (EH) and Environmental (EN) Divisions. Administrative support and counsel were provided by Dr. R. K. Jain, Chief of EN. Team members were Robert Porter (team leader), Roger Brauer, David Dressel, Robert Fileccia, Sharen Kloster, Charles Lozar, Joseph Matherly, Mary Staub, Jerry Benson, and Wayne Veneklasen. Additional CERL input was provided by Paul Howdyshell, Larry Windingland, Tom Napier, and Michael Golish. Special recognition is expressed for the major contribution of WO Don Siegfried, U.S. Army Armor Center, Ft. Knox, KY. His extensive experience in Army and civilian vehicle maintenance facilities was valuable in developing the recommendations for improved facilities.

COL L. J. Circeo is Commander and Director of CERL, and Dr. L. R. Shaffer is Technical Director.

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Introduction

1 INTRODUCTION

Background

U.S. Army vehicle servicing and washing facilities are the primary locations for accomplishing the maintenance operations required to keep Army tactical vehicles combat-ready and for training Army maintenance personnel. Design of these facilities must also provide for pollution abatement, energy conservation, facility construction economy, and operating personnel efficiency. According to AR 415-20,¹ the using service is responsible for providing designers with a construction project's functional requirements. Army DD Form 1391 and the PDB (Project Development Brochure) require functional requirement design information for Army vehicle servicing and washing construction projects. Throughout this document, the term "maintenance facility" refers to both servicing and washing facilities.

Objective

The objective of this document is to provide a comprehensive set of planning concepts pertinent to tactical vehicle maintenance construction projects.

Development of Planning Concepts

This document presents several categories of information related to the generic functions at Army maintenance facilities. "Generic" refers to functions that are generally operational for any existing facility or military unit. In progression, the planning concepts first were generated in terms of relating Army policies to the Activities, Personnel, and Equipment required to accomplish a specific Function. Next, Requirements and Criteria for the facility work stations were developed. Finally, planning concepts in the form of potential guidance relating to specific building or exterior operational areas were generated. Thus, the Requirements, Criteria, and Guidance information provide the "optimum" settings for current Activities. Relevant information about

¹ Construction Project Development and Design Approval, AR 415-20 (Department of the Army [DA], 28 March 1974).

"advanced" maintenance and cleaning practices obtained from discussions with personnel of Army units, trucking/transportation/construction/industry operators, and from review of current periodicals and research literature was also developed. *"Advanced" practices are those working conditions, equipment items, maintenance policies, etc., that are not currently a part of the U.S. Army methods of operation. Therefore, to include these items in a project PDS, the user group must obtain special approvals, funding sources, or waivers, etc.* The information has been integrated into a four-page format, so that all information starting with the policies related to a particular function on through to the space layout sketches can be viewed together. This organization will permit ready incorporation of applicable information into appropriate Design Guides, Technical Manuals, and standardized design criteria.

Scope

This document provides planning concepts for all the generic functions associated with both Organizational and Direct Support maintenance for most Army vehicles. Thus, this information will be useful to all military components requiring project-specific information, whether it will be used for developing new construction projects or for renovating existing facilities. Planning concepts which are now considered "advanced" practice for purposes of this document could eventually be considered as "optimum" Army practice.

Mode of Technology Transfer

Office, Chief of Engineers, may use these planning concepts in revising standardized design criteria and in revisions of TM 5-841-1² and Design Guide (DG) 1110-3-80.³

² Space Planning Guide for TOE Maintenance Facilities, TM 5-841-1 (DA, April 1979).

³ TOE Maintenance Complexes, DG 1110-3-80 (under development).

Sources of Information

The information in this document was obtained from installation and unit facility users, and from DA and MACOM personnel. Documents currently used for determining facility designs have been referenced, including TM 5-841-1 and DG 111G-3-80.

Types of Information

The page formats of the document contain eight specific types of information. (See any "function" set of pages in Chapter 3 for an example.)

1. function: This is a statement of overall mission for a specific part of the maintenance or cleaning facility.
2. policy: These are the regulations which define what must be done and how it should be done. The information is taken from documents such as Army Regulations, Field Manuals, and Standards of Procedure.
3. issues: This tells how the functions should be improved, or indicates whether there are "trade-offs" related to pollution, efficiency, or economy issues.
4. assumptions: These justify the recommendations for function performance as statements of the conditions upon which the facility information is based.
5. activities/personnel/equipment: These state specifically how the functional operations should be performed.
6. requirements: These are qualitative statements of objectives, written in performance language, that describe a facility's objectives and its technical needs.
7. criteria: These statements, developed directly from the requirements list, provide the quantitative and/or qualitative means of determining the appropriate design solution for a facility.

8. guidance: Planning concepts have been translated into potential guidance in the form of statements, sketches, and diagrams to provide realistic advice, based on design experience, regarding the appropriate, "optimum" solution.

Using This Document

This document provides tactical vehicle maintenance facility planning concepts based on relevant background information. DA and MACOM personnel can use this information to evaluate the policy modifications required for the construction or equipment procurement needed to carry out a described maintenance practice if it is desired to implement it.

Readers interested in developing policies regarding vehicle maintenance operations, equipment, and facilities should focus on comments about space criteria in Chapter 2, the recommendations listed in Table 3-1, the policy and issues columns, and some of the items in the equipment columns for each space in Chapter 3.

Readers interested in developing functional requirements for a construction project should primarily focus on Chapter 2 in sizing spaces, the function, activity, personnel, equipment, and requirements columns in Chapter 3, and the space relationship diagrams in Chapter 4.

Readers interested in development of design criteria and guidance should give attention to Chapter 2, Table 3-1, the requirements, criteria, and guidance columns for each space in Chapter 3, and the format for presenting facility information. As noted in Chapter 3, the numerical values for criteria, dimensions, etc., need further evaluation and validation.

If readers are interested in building design information, this document might be used with TM 5-841-1 and DG 1110-3-80 to gain further insights into the requirements of a using service.

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Space Analysis for Facility Planning Purposes

2 SPACE ANALYSIS FOR FACILITY PLANNING PURPOSES

General Space Guidance

One of the most basic requirements of designing Army maintenance facilities is determining a rational basis for generating space requirements from stated user needs in the form of functional requirements. These functional requirements are prepared as the basis for both 1391 and project development brochure (PDB) preparation. When the actual construction drawings are prepared, such guidance is useful for determining both the actual sizes of spaces and the funding levels and costs per square foot. Therefore, it is important that all the participants involved in preplanning are working with the same source of how the space requirements are generated and where certain space allocations are negotiable in terms of variations. To this end, two basic documents provide guidance for generating space requirements in TOE maintenance shops.

Space Reference Documents

Each maintenance space is operated either at the Battalion level or the Company level. As such, the Table of Organization and Equipment (TOE) is a basis for selecting the equipment, personnel, and job specialties necessary to accomplish the mission of a particular organization. For example, the TOE for the armored Battalion will specify both the personnel and the specialty codes for the various jobs required to maintain all of the Battalion's equipment. Obviously, for vehicle maintenance shops, the most important specialty codes (MOS codes) are those dealing with vehicle maintenance; these will serve as the basis for generating many of the space requirements later on. TM 5-841-1, *Space Planning Guide for CONUS TOE Maintenance Facilities* (March 1977) translates personnel allotment, vehicle mix, and the MOS code information into space criteria by describing the rationale for structuring space allotments to accommodate mission needs of the various Battalions and Companies. DG 1110-3-80, *TOE Vehicle Maintenance Complexes* (August 1979), provides the user with a better understanding of the space allotments and how they work for the entire complex. This document specifies overall planning procedures for vehicle maintenance facilities and provides space guidance not specified in TM 5-841-1.

Comparison of Space Guidance Rationale

The rationale for space allocation provided in TM 5-841-1 is based on the evaluation of properly designed shop maintenance facilities. The TM translates specific space requirements into square feet. The number of bays required to accommodate vehicle repair and maintenance is based on the number of personnel assigned to various Battalions, which is specified in the TOE. "The MOS codes specify the relationship between vehicle mix and the number of mechanics required to service those vehicles." Tables 3-1, 3-2, and 3-3 of the TM list these codes and translate them into space requirements based on where these personnel would work in the building.

The rationale for developing space allocations presented in DG 1110-3-80 focuses on areas not described in the TM. These are usually exterior areas, such as washracks, filling stations, outdoor maintenance areas, deployment storage, and TOE vehicle parking. By reviewing the space allocation rationale presented in both documents, it is possible to compare overall comprehensiveness as presented in Table 2-1 of this document. This table also compares the rationales specified in the TM with those specified in the DG. A comparison of the rationales for the layout of a maintenance shop's various specific functional areas shows that they are complementary. Thus, by using both documents as references, the users are provided with a set of criteria for allocating space, which will enable them to determine the necessary planning requirements for 1391 or PDB preparation.

The Space Planning Process

Figure 2-1 shows the space planning process used to determine maintenance facility space allocations. This flowchart is based on review and compilation of the TM and the DG. The chart is divided into four sections, all based on the assumption that TOE is the starting point for determining Battalion size specialty codes, and necessary equipment. After the users have extracted the MOS codes for mission accomplishment, they should fill out forms A and B in the Appendix of TM 5-814-1, and then begin determining the allocations for each area. In some cases, as shown in Table 2-1, the basis of space determination can be the total number of individuals, the vehicle mix reflected in the MOS codes, or the various allotments of equipment necessary to accomplish the mission. Once these quantities are known, the square footage requirements can be generated quickly from the guidance contained in either document. Figure 2-1 also shows some

| SPACE NAME | DESIGN INFORMATION SYMBOL | RATIONALE FOR SPACE ALLOCATION FROM TM 5-841-1 SPACE PLANNING GUIDE | MINIMUM FACTOR | RATIONALE FOR SPACE ALLOCATION FROM TM 5-841-1 SPACE PLANNING GUIDE |
|-----------------------------------|---------------------------|--|----------------|--|
| Maint. Off. | OM11 | 80 sq ft/person assigned to the function | 5 | |
| Maint. Bay | OM1, OM2 | Based on drive-thru design (Refer to MDS Est. 3 persons/bay (both sizes: codes and TM) | 1.0 | |
| Bay Support | - | 80 sq ft per bay (both sizes) | 1.0 | |
| Tool Box Stor. | OM17 | If less than 6, no storage If 6 or more, provide 24 sq ft/person for stor | 1.0 | 1 sec/company on 2-3 4 x 8 ft. boards |
| Maint. Supply Area (Painting Bay) | OM16 | - | - | 80 sq ft for each company |
| Generator Storage & Shop | OM4 | Not discussed specifically. (Same as General Item Repair below) | 1.0 | - |
| Welding Shop & Bay | OM6 | - | - | Not discussed. |
| Dr/PL Parts Mgt. | OM18 | 300 sq ft/person assigned to this area including parts/shelf stor. | 1.0 | No space/usually at end of common use bay with vent & door |
| Battery Shop | OM7 | 1-2 chgs = 300 sq. ft. 3 or more = 600 sq. ft. | 1.0 | - |
| Tire Shop | OM5 | Not discussed. | - | - |
| General Item RPR | OM4 | 98 sq ft/person = 120 sq ft (mult. of 10 persons for parts, cing & stor.) | 1.5 | Not discussed |
| Arty-fire Control | OM9 | 59 sq ft/person = 120 sq ft (mult. of 10 persons). | 1.5 | - |
| CO Comm. | OM9 | 59 sq ft/person = 120 sq ft (mult. of 10 persons). | 1.5 | - |
| BN Comm. | OM9 | 59 sq ft/person = 120 sq ft (mult. of 10 persons). | 1.5 | - |
| Special Env. Shop | - | 88 sq ft/person = 120 sq ft (mult. of 10 persons). | 1.5 | - |
| Grease Rack | OM11 | - | - | Allocated on basis of shop size |
| Wash Rack | OM13,14 | - | - | One wash platform/50 org. vehicles |
| Fueling | OM22 | - | - | 1 dispensing nozzle/50 vehicles = 120 sq ft control house |
| Outdoor Maint. Area | OM11, 12 | - | - | Base on unit req. & mission and no. of vehicles/determined by using service (See Fig. 2-1) |
| POL Office | OM22 | - | - | (Part of General POL) |
| POL Storage | OM22 | - | - | 50' away from bldg/60 sq ft of secured covered area/25 veh |
| Sentry/Dispatch Post | OM24 | - | - | 250 vehicles or less = 195 sq. ft. 250 or more = 300 sq. ft. |
| Geoloyment Stor. | OM25 | - | - | 600 sq. ft = 10% of overall area |
| TDE Vehicle Park. | OM23 | - | - | 50-75 sq yds/vehicle (See TM 5-840-1) |
| BN Admin. | OM15 | Based on 90 sq. ft./person. | 1.5 | - |
| PLL | OM18 | 2 sq ft/person = multiply total facility personnel | 1.0 | - |
| Break/Classroom | OM19 | (Total facility occupancy/50) x 100 sq ft = total area | 2 | - |
| Latrines | OM21 | 10 persons or less use 38 sq ft. If more than 10, total pop./10 x 38 sq ft. | 1.5 | - |
| POL Parking | OM26 | - | - | 35 sq yds/vehicle based on 388 of assigned personnel |

* NOTE: Refer to TM 5-841-1 for Utilities, Walls, Aspect Ratio, etc. Factors to be Used in Space Assignment.

18 Table 2-1 Space Guidance: Allocation Rationale

areas for which neither document contains guidance. These areas reflect a need for the further investigation in the development of space requirement guidance that is partially included in this document.

Comments on Guidance for Space Usage in TOE Shops

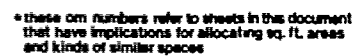
The guidelines for the allocation of space presented in the Space Planning Guide, TM 5-841-1, are the result of work done by Industrial Engineering Firm, FMC Corporation, after looking at a number of Army and industrial maintenance shops. This report was done through Norfolk District offices and submitted to OCE for incorporation into the written TM in 1976. This report served as the basis to look at a broad range of Army TOE facilities and to construct equations for space allocation. Additional planning information needed includes:

1. The allocation of space for innovations or changes in the existing equipment.
2. An examination of existing operating procedures which may impact on the allocation of space or its arrangement.
3. New ways of relating functional areas based on statistical documentation derived from existing facilities.
4. Future technological innovation. Possible space allocation impacts can result from changes in vehicle design and equipment (particularly the development of new mobile equipment with electronic gear), and changes or innovations in servicing equipment policies or procedures.

Referring to Figure 2-1 (Space Allocation Process), five specific allocations of space should be noted.

1. The allocation of PLL storage. The problem with this particular allocation (2 sq ft per person in the facility), as presented in the TM, is that it represents an average of existing facilities examined. In an armored Battalion, this space allocation is not enough because it is necessary to store large tracks for the tracked vehicles in PLL. With the removal of this space allocation for tracks, the 2 sq ft per person is too much for an armored Battalion. On the other hand, for a transportation Battalion, 2 sq ft per person is not nearly enough space to handle all the PLL equipment. The allocation presented in the TM is the result of averaging across different

**Figure 2-1 Organizational TOE
Maintenance Facilities
Space Allocation Process**



types of Battalions and must be reconfigured to account for the variation across Battalion PLL storage.

2. Parachute shop. Guidelines in the allocation of shops as presented in the TM or DG are not comprehensive. Although they provide some indication of the space allocation necessary for shaking out and reassembling parachutes, there is no indication of a configuration or space necessary for a drying tower, a shakeout area, nor of the size or recommended configuration in material required for a parachute repair table.

3. Waste treatment. Although the DG does present some configurations for particular waste treatment facilities, some guidance is necessary for sizing the major site area for settlement basins, grit chambers, or oil separation containers.

4. Direct Support spaces. Most of the space requirements and names of individual shop areas are presented for Organizational maintenance only. The TM specifically needs to indicate differences in Organizational and Direct Support space allocations and the types of servicing necessary for each (i.e., deployment van storage next to the building).

5. The TM does not give the relationships between various areas of a TOE shop in terms of specific detailed flow relationships. The DG does present some of these, but there is no single comprehensive diagram which gives the relationships between space allocation and the flow of items (refer to the charts in Chapter 4 of this document).

One of the major issues in a TOE shop design is flexibility to accommodate the different types of Battalions which have different needs for space, i.e., Armored, Transport, etc. Since the MOS codes from each Battalion type dictate the kinds of space and necessary supplementary spaces required to service that Battalion, each TOE complex is oriented toward a specific Battalion type. In theory, this is acceptable; however, in practice, Battalions are often switched between various TOE facilities with little regard to whether the facility was originally designed for that type of Battalion. Some serious consideration in space allocation must be given to structuring an optimum facility which will accommodate the flexibility required.

An adequate working area is basic to all of the functional spaces presented in this document. Chapter 3 includes some recommendations that will impact the kind of space allocations presented in Figure 2-1 (and the criteria in Table 2-1). These recommendations in space allocations are identified in Figure 2-1 with an asterisk (*) next to the organizational maintenance (OM#) sheet number.

3

Generic Facility Information

3 GENERIC FACILITY INFORMATION

The following pages provide facility information related to 34 generic maintenance functions performed on most Army vehicles. The functions which are discussed apply only to Organizational and Support levels of maintenance. Other levels of maintenance, such as TDA and Depot, are beyond the scope of this information.

Each function is presented as it could be currently practiced with optimum facilities, and also as "advanced" maintenance practices that are not typically seen in Army Tactical Shops. This information can be used for new construction of maintenance facilities or the retrofitting of existing ones requiring modernization to come into compliance with pollution control standards.

Specific facility recommendations are indicated at the beginning of most of the four-page sets. These recommendations include a brief background, detailed recommendations, implications, and benefits for the facility and Army personnel. All recommendations focus on pollution abatement, energy conservation, personnel effectiveness, or construction economy.

The information should be considered as recommendations. The spaces, sizings, dimensions, etc., are approximations that need to be evaluated and validated by individuals developing PDB's. Unique needs and differences between types of vehicles being maintained need to be considered when specific projects are being planned.

Information presented here was drawn from a wide variety of sources both within and outside the military: TM 5-841-1 Space Planning Guide for TOE Maintenance Facilities; Design Guide 1110-3-80 T.O.E. Maintenance Complexes; American Concrete Institute Handbook; Illuminating Engineering Society Handbook; Architectural Graphic Standards; construction guides for fleet maintenance facilities; trips to trucking facilities; and others. Most importantly, the bulk of the information was provided by those individuals who spend their working hours in the shops themselves -- the Battalion Maintenance Officers, Motor Sergeants, and mechanics.

FACILITY RECOMMENDATIONS: Scheduled and Unscheduled Maintenance Bays

BACKGROUND: Presently, oil changing and maintenance cleaning of tactical equipment are relegated to outside hardstand areas, principally at grease racks and washrack facilities. This condition makes it extremely difficult to control the discharge of POL products to the environment at contaminant concentrations acceptable to regulatory authorities. New guidance in the form of TM 5-841-1, Space Planning Guide for CONUS TOE Maintenance Facilities, and OG 1115-3-80, TOE Maintenance Complexes, does not provide adequate guidance to prevent these practices at new TOE Maintenance complex construction. In addition, the new guidance does not recognize the fundamental flow of vehicular maintenance activities at the organizational level.

RECOMMENDATIONS: Allocation of maintenance bays is to be made on the basis of scheduled and unscheduled maintenance requirements. At the scheduled maintenance complex, lift capability--both overhead and ground level jack stands, oil changing, greasing, fluid level checks and replenishment, inspection services, small parts cleaning, and maintenance cleaning capability of whole vehicles (both tracked and wheeled) and component parts are to be provided. Unscheduled maintenance bays are to be provided with the same capability as scheduled maintenance bays with the exception that oil changing and maintenance cleaning facilities would not be provided.

An oil analysis program should be implemented for all TOE vehicle types.

IMPLICATIONS FOR THE FACILITY: TOE maintenance complexes would be designed on the basis of scheduled and unscheduled maintenance requirements to allow for the performance of all wet and virtually all dry maintenance activities to be performed under roof.

An oil analysis program would help predict parts wear and engine failure and oil change requirements. Sampling equipment and laboratories for analysis would be required.

- BENEFITS:**
- (1) positive pollution abatement and control at minimum cost
 - (2) significantly increased efficiency in the performance of tactical vehicle maintenance operations
 - (3) improved readiness from the standpoint of equipment availability
 - (4) resource conservation through efficient handling and storage of new and waste oil, and other petroleum products
 - (5) improved morale at the organizational level
 - (6) an oil analysis program would:
 - (a) establish a vehicle operational history
 - (b) could be used as a tool for performing preventive maintenance and determining oil change requirements, thus reducing vehicle down time and overall maintenance and supply costs.

function

To Meet the Scheduled Service Requirements of Tracked-Based TOE Organizational Units

policy

Common SOP requires all tracked vehicles to be cleaned and serviced quarterly and some tracked vehicles to be cleaned and serviced after field operations.

**OM-1
SCHEDULED MAINTENANCE BAY**

issues and assumptions

1. Scheduled maintenance on tactical equipment can be performed more efficiently and provide for positive pollution control if the proper enclosed facilities and equipment are provided.
2. Use of the scheduled maintenance bay is under DOD control.
3. Unscheduled maintenance performed at Company level maintenance bays is provided. (See "Unscheduled Maintenance Bays.")
4. It is desirable to be able to remove crankcase and transmission oils in tracked equipment with either the power pak in or removed from the vehicle.
5. If an "Oil Analysis Program" were universally established for vehicle crankcase oil, facility impacts would be:
 1. Fewer scheduled maintenance bays required.
 2. Less use of depot-level overhaul of power paks.

activities

1. Oil and oil filter changing for wheeled and tracked equipment.
2. Fluid level checks.
3. Radiator flushing for water cooled engines.
4. Power pak removal.
5. Power pak cleaning.
6. Hull cleaning.
7. Gun tube replacement.
8. Gun tube cleaning.
9. Tire changing.
10. Greasing and lubrication for wheeled and tracked equipment.
11. Ground-hopping of tracked equipment.
12. Power pak replacement.
13. Large component parts cleaning (heatshields, fuel cells, etc.)

personnel

1 to 3 per bay, a function of vehicle scheduled maintenance requirements

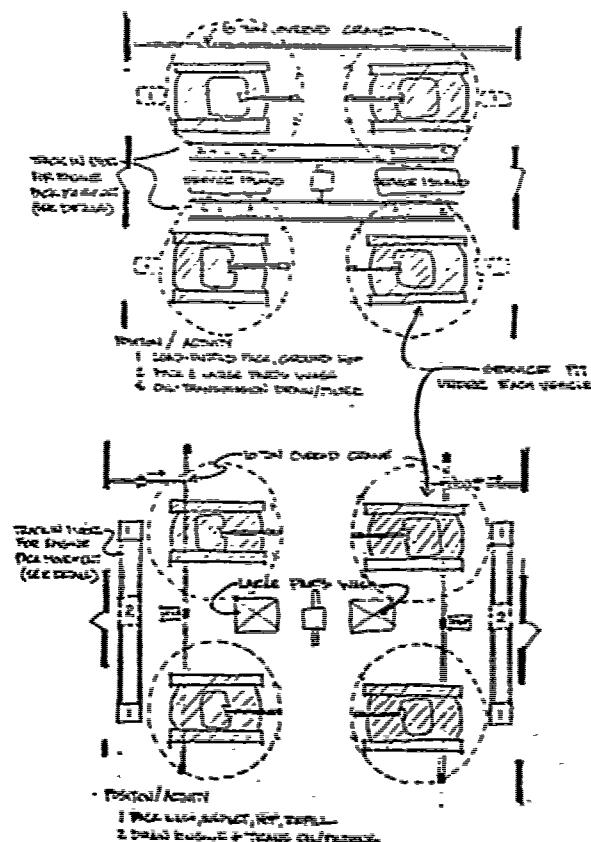
equipment

- 1. Movable slitting waste oil collection funnels, underdischarging to waste-oil collection trough.
- 2. Steam hot water cleaners.
- 3. Fluid dispensing system with retractable hoses.
- 4. Floor jacks, either portable or fixed in floor.
- 5. Power pak dollies.
- 6. Solid waste storage.
- 7. Recirculating small parts solvent washer.

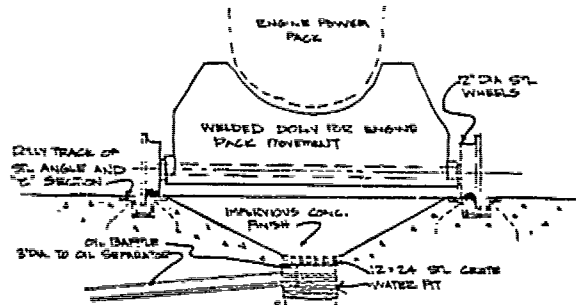
| requirements | criteria |
|--|---|
| 1. Adequate space to meet the service requirements of four tracked or large wheeled vehicles simultaneously. | 1. See TM 5-641-1 for basic bay dimensions, and "guidance sketches" for "between" bay areas. |
| 2. Vehicle and personnel access. | 2. Bays to have drive-through capability, 15 ft. wide x 20 ft. high vehicle doors to be motorized. Personnel doors (3 ft. x 7 ft.). |
| 3. Electrical power. | 3. 110V and 220V. |
| 4. Retractable dispensing lines for servicing vehicles. | 4. Transmission oil, gear oil, water, compressed air, 2 grades of lubricating oil, and hydraulic fluid (Engine Oil). |
| 5. Wastewater pretreatment with discharge to sanitary sewer. | 5. (See "Wastewater Treatment" in Section 4.) |
| 6. Waste receptor systems. | 6. Solid waste receptacles, waste solvent collection system, and waste oil collection to outside underground waste oil storage. |
| 7. Light on all vehicle exterior surfaces. | 7. 30 f.c. |
| 8. Two position vehicle exhaust system at each bay. | 8. - |
| 9. Moisture removal and control system. | 9. - |
| 10. Lift capability. | 10. 10 ton capacity traveling bridge crane. |

guidance

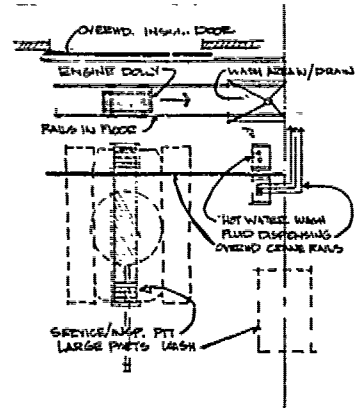
SCHEDULED MAINTENANCE BAYS: ALTERNATIVES (4 BAYS IN EACH GROUPING)



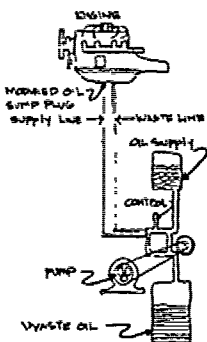
guidance



SECTION THRU DOLLY WASH PIT FOR BAY

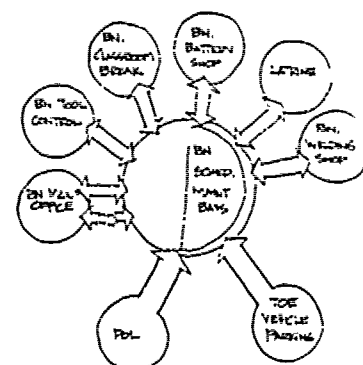


1/4 OF TYPICAL MAINTENANCE
BAY LAYOUT (SEE DETAIL SHEETS
FOR ENGINE DOLLY, MSP, PIT, & DOLLY WASH)



OIL EVACUATION SYSTEM

guidance



FACILITY RECOMMENDATIONS. Scheduled and Unscheduled Maintenance Bays

BACKGROUND: Presently, oil changing and maintenance cleaning of tactical equipment are relegated to outside hardstand areas, principally at grease racks and washrack facilities. This condition makes it extremely difficult to control the discharge of PCB products to the environment at contaminant concentrations acceptable to regulatory authorities. New guidance in the form of IM 5-541-1, Space Planning Guide for CORUS TGE Maintenance Facilities, and DG 11-1-3-85, TGE Maintenance Complexes, does not provide adequate guidance to prevent these practices at new TGE Maintenance complex construction. In addition, the new guidance does not recognize the fundamental flow of vehicular maintenance activities at the organizational level.

RECOMMENDATIONS: Allocation of maintenance bays is to be made on the basis of scheduled and unscheduled maintenance requirements. At the scheduled maintenance complex, lift capability--both overhead and ground level jack stands, oil changing, greasing, fluid level checks and replenishment, inspection services, small parts cleaning, and maintenance cleaning capability of whole vehicles (both tracked and wheeled) and component parts are to be provided. Unscheduled maintenance bays are to be provided with the same capability as scheduled maintenance bays with the exception that oil changing and maintenance cleaning facilities would not be provided.

An oil analysis program should be implemented for all TGE vehicle types.

IMPLICATIONS FOR THE FACILITY: TGE maintenance complexes would be designed on the basis of scheduled and unscheduled maintenance requirements to allow for the performance of all wet and virtually all dry maintenance activities to be performed under roof.

An oil analysis program would help predict parts wear and engine failure and oil change requirements. Sampling equipment and laboratories for analysis would be required.

- BENEFITS:**
- (1) positive pollution abatement and control at minimum cost
 - (2) significantly increased efficiency in the performance of tactical vehicle maintenance operations
 - (3) improved readiness from the standpoint of equipment availability
 - (4) resource conservation through efficient handling and storage of new and waste oils and other petroleum products
 - (5) improved morale at the organizational level
 - (6) an oil analysis program would:
 - (a) establish a vehicle operational history
 - (b) could be used as a tool for performing preventive maintenance and determining oil change requirements, thus reducing vehicle down time and overall maintenance and supply costs.

OM-2 UNSCHEDULED MAINTENANCE BAY

function

To perform unscheduled vehicle maintenance repair at the organizational level.

policy

issues and assumptions

1. Company unit integrity and facility layout

Currently recommended layouts for grouping company spaces (a) do not provide for circulation between bays via an interior route, and (b) require a large clear-span for the building structure. Indoor circulation routes are more convenient, and shorter clear-spans are less expensive. Grouping company spaces also enhances unit integrity.

2. Extent of activities performed in bays.

- a. Two in-line bays are adequate to meet the unscheduled maintenance and repair requirements of each company (normally 5) of a TOE organizational unit.
- b. Currently, minimal tire-changing tools are provided at the organizational level. Tire changing is therefore inefficient and hazardous, resulting in damage to tires and rims and injuries to personnel. (See "Tire Shop" sheets.)

3. Overhead hoist for materials lifting.

Currently, there is no provision for other than manual lifting capability in some bays. Personnel are injured, and equipment is damaged if manual lifting is used to remove and replace moderately heavy parts.

- (a) A small hoist will reduce injuries and equipment damage.
- (b) Parts to be lifted weigh more than 100 lb.

activities

1. Inspection
2. Removal and replacement of parts
3. Diagnostics
4. Minor repairs.
5. Gun tube replacements
6. Tire changing and repairs
7. Radiator flushing for water cooled engines
8. Ground-hopping of tracked equipment

personnel

variable, function of maintenance or repair operations

equipment

1. Tool kit
2. Jack, portable or fixed
3. Solid waste storage
4. See "Tire Shop" sheets.
5. Fluid dispensing system with retractable hoses
- Recirculating small parts solvent washer

requirements

1. Bay area, one double drive-through with an inspection pit in one.
2. Oil door to outside and personnel door for each bay.
3. Power.
4. Utilities for the fluid dispensing unit.
5. Sanitary sewer drain both bays.
6. Vehicle exhaust system.
7. Working temperature.
8. Lighting.
9. Non-skid floor surface.

10. Provide light crane in at least one bay per company to help lift parts being removed or replaced.

(If bay layouts of several Companies are adjacent, possibly a traveling bridge crane servicing all unscheduled maintenance bays should be considered.)

criteria

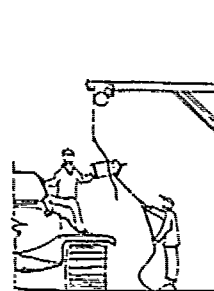
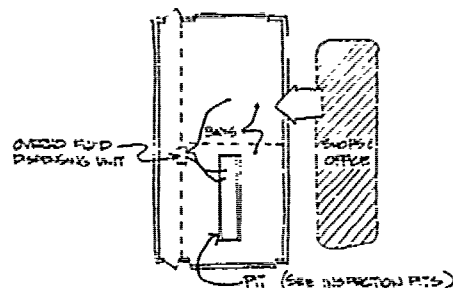
1. 24 ft. x 32 ft. (see guidance sketch).
2. Powered Oil door (15 ft. x 18 ft. high). Personnel door (3 ft. x 7 ft.).
3. 110V.
4. Transmission oil, gear oil, water, compressed air, engine oil (2 grades) and hydraulic fluid.
5. "
6. "
7. 68°F. winter.
8. General lighting 30 f.c. with retractable trouble lights.
9. Class 5 concrete slab (ACI).

10. 2 tons capacity (exact size to be determined for specific project).

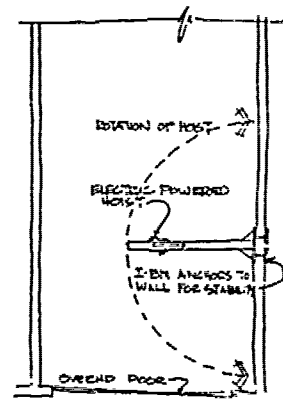
(2 to 5 tons, or as determined for specific project.)

guidance

1. Company bays should be near Company shop control, rest v. and toilet rooms.
2. Convenient access to battalion offices, P.O., and tools or an common-use bay.

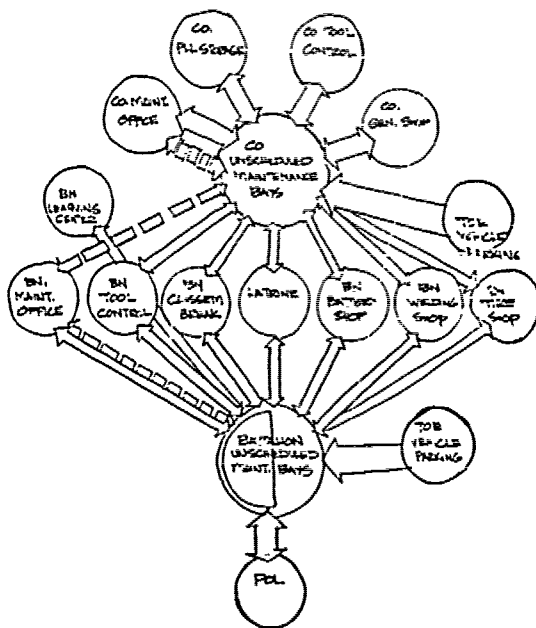


BAY SECTION



BAY PLAN

guidance



FACILITY RECOMMENDATIONS Service Pits

BACKGROUND: Service pits existing at Army tactical vehicle maintenance shops generally are restricted to use by wheeled equipment for oil changing and general inspection service. Generally, they are not lighted, have poor or no direct ventilation, are difficult to clean, have inadequate waste oil collection and storage facilities, and have no maintenance support equipment (compressed air, electrical, oil dispensing) associated with them.

RECOMMENDATIONS: Installation of service pits capable of handling tracked and wheeled vehicles; i.e., full service pits provided with lighting, ventilation, waste oil collection facilities, electrical power and bottom drain for cleanup. Fluid dispensing equipment and auxiliary lighting to be provided within easy access to each service pit area.

IMPLICATIONS FOR THE FACILITY: Exterior grease racks would be eliminated. TOE maintenance facilities to be provided with sufficient service pit and service pit/clear floor combination bays to accommodate the performance of virtually all tactical vehicle maintenance operations indoors.

BENEFITS: Minimization and control of pollution discharges, conservation of petroleum-based products and increased efficiency of maintenance operations within the TOE maintenance complex would result.

function

Performing inspections, maintenance, lubrication and oil changes of the underside of vehicle

policy

OM-3 SERVICE PITS

issues and assumptions

1. Inspection pit usage vs. grease racks

- a. Oil and grease racks are inadequate because 1) they cannot be used in inclement weather, 2) are not designed for the convenience of the users, 3) result in significant oil and grease spills.
- b. Inspection pits for "dry activities" would be provided in Company days.
- c. "Oil and greasing" pit(s) would be provided central in the Battalion shop for use by all. The number required is dependent on the capacity of a pit to support vehicle servicing at an adequate rate.
- d. A "washing" pit would be provided as part of the vehicle washing facility that is semi-enclosed or completely enclosed.

activities

UNRECORDED MAINT. PIT

1. Drive vehicle on and off pit.
2. Inspect
3. Adjust
4. Remove and replace parts
5. Test vehicle

personnel

1 mechanic

equipment

See guidance sketches.

SCHEDULED MAINT. PIT

1. Drive vehicle on and off pit.
2. Drain and/or replace:
engine oil
transmission fluid
gear/transmission oil
hydraulic fluid
brake fluid
3. Grease components.
4. Remove and replace parts.
5. Test vehicle.

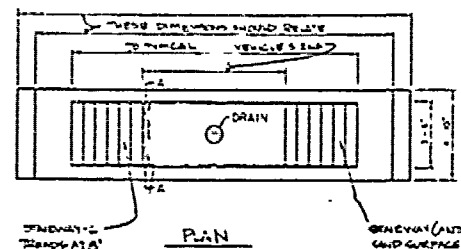
1 mechanic.

(See guidance sketches.)

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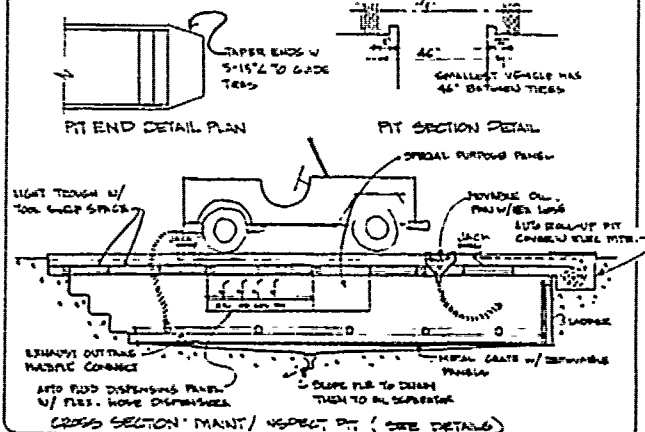
| requirements | criteria |
|---|--|
| UNSCHEDULED MAINTENANCE PIT | |
| 1. Adequate size. | 1. One vehicle long, track width for narrowest vehicle |
| 2. Access from bay floor. | 2. Stairs to pit floor, one end |
| 3a. Power for tools. | 3a. 110V. |
| 4a. Sanitary sewer (mainly for cleaning or emergency use). | 4a. To wastewater treatment (possibly requiring sump pump). |
| 5a. Lighting of vehicle underside | 5a. Fluorescent, diffuser directing light upward, 20 ft.-candles. |
| 5b. Retractable trouble light. | 5b. - |
| 6. Exhaust ventilation. | 6. 12 air changes per hour, grills near pit floor. |
| 7. Place to temporarily store tools and parts. | 7. Provide recesses into pit wall |
| 8. Curb around pit perimeter to: a) keep water out and b) to guide vehicles over pit. | 8. 4 in. min., 6 in. max. |
| 9. Protective cover or guardrail to prevent people from falling in when pit is not in use. (OSHA) | 9. - |
| 10a. Provide retractable dispensing lines for: a) compressed air b) gear oil c) grease | 10a. - |
| 11. Non-slip floor. | 11. - |
| 12. Position-adjustable jacks (4 locations) to lift wheels. | 12. - |
| SCHEDULED MAINTENANCE PIT (SAME AS UNSCHEDULED MAINT. PIT EXCEPT:) | |
| 3b. Power for pumps. | 3b. May require 220V. |
| 4b. Waste must be run through oil separator before draining. | 4b. Waste must be run through oil separator before draining to wastewater treatment. |
| 13. Oil collection system: | 13. Movable drain pan, direct line to collection tank and oil evacuation system. |
| 14. Water-proof electrical fixtures and good drainage of all parts of pit. | 14. - |

guidance

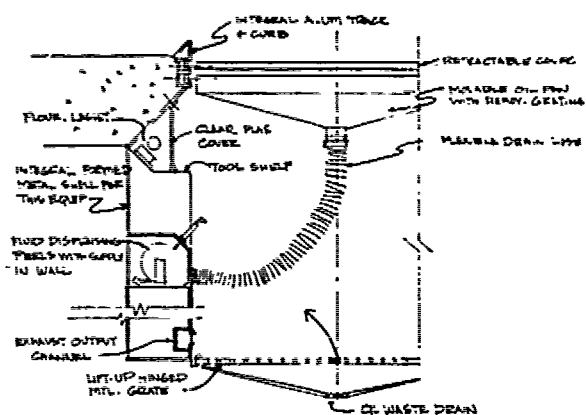


STANDARD COMMON INSPECTION PIT DESIGN

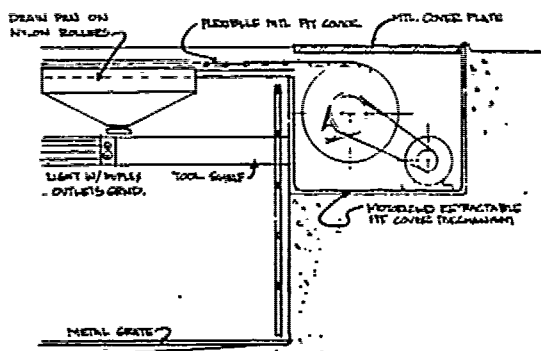
IMPROVED OPTIMUM MAINT/INSPECTION PIT DESIGN



guidance



SIDE - SECTION - THRU PIT



SECTION AT THE END OF PIT

**OM-4
GENERATOR SHOP**

function

1. Maintain, Repair and Store Generators, etc.

policy

At both Battalion and Company vehicle maintenance areas there is the need to inspect and repair vehicle component parts, such as generators, and other general work bench scale items. The work areas per work station are identical for both the organizations, except the required storage shelving is about five times larger for such Battalion equipment.

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FACILITY RECOMMENDATIONS: Tire Shop and Related Equipment

BACKGROUND: Tire changing operations at most existing organizational maintenance shops are carried out using strictly manual methods. Lack of proper equipment, such as a tire spreader/demounter and tire inflation cage, as well as the provision of an assigned space, have led to operational inefficiencies, damage to tires and safety hazards for the user.

RECOMMENDATIONS: A tire changing and repair space, including all necessary equipment, should be provided at the Battalion level for all TDE maintenance shops.

IMPLICATIONS FOR THE FACILITY: Improved tire changing operations in a separate, dedicated space.

BENEFITS: Increased efficiency and personnel safety in tactical vehicle tire changing operations.

OM-5 TIRE SHOP

function

wheeled vehicle tire changing and repair

policy

Tire changing is authorized at the organizational maintenance level

Issues and assumptions

1. Tire changing location
Currently tire changing occurs in the typical maintenance bay area or adjacent hardstand areas.

Advanced Practice 1: Existing guidance does not allow either the space or equipment for the efficient or safe handling of tire changing operations. It can take up to 3 1/2 man-hours to replace a tire on a wheel. Manual tire changing is hazardous for personnel using only "tire irons." Tire structures and beads are frequently damaged during manual operations.

1. An impact wrench would speed wheel removal and replacement.
2. A commercial-type tire changer will speed tire removal and replacement, require fewer men per tire changing job and be safer than muscle and tire irons.
3. "Goer" series vehicles will be handled at a DS Shop.

| activities | personnel | equipment |
|---|------------|---|
| <ol style="list-style-type: none"> 1. Break up debris 2. Remove wheel 3. Break tire from wheel 4. Leak-test tire 5. Repair or replace tire or tube 6. Inflate tire 7. Replace wheel on vehicle 8. Store waste tires | Technician | <ol style="list-style-type: none"> 1. Hydraulic 2. Tire rack 3. Soap solution or water bath 4. Compressed air 5. Tire racks for temporary storage, 10 linear feet |
| <ol style="list-style-type: none"> 1. thru 8, same as above | Mechanic | <ol style="list-style-type: none"> 1. Hydraulic 2. Impact wrench 3. Soap solution or water bath 4. Tire spreader/demounter combination for use on truck tires of up to 60 inch diameter and size unit to have built-in lamp for tire inspection 5. Tire inflation cage 6. Cabinet for storage of tire irons, vulcanizer for tube-type tires, accessories for tire machine, etc. 124 in x 42 in x 60 in, high 7. Tire racks for temporary storage, 10 linear feet |

| requirements | criteria |
|-------------------------------------|-----------------|
| 1. Compressed air. | 1. 120-175 psi. |
| 2. Electrical service | 2. 110V. |
| 3. Water supply and sanitary drain. | 3. - |

guidance

1. Space convenient to exterior door (6ft. W or OH).

2. Tire shop should be centrally located in the Battalion shop.

3. Shop must be on the ground floor of facility.

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FACILITY RECOMMENDATIONS Welding Shop

BACKGROUND. Existing guidance does not address the requirements for space, safety equipment, or associated support features for the performance of welding operations at TOE maintenance complexes.

RECOMMENDATIONS: Space, necessary safety equipment, and associated support features should be provided for in TOE maintenance complexes.

IMPLICATIONS FOR THE FACILITY: Provision of space and supportive equipment for welding at TOE maintenance complexes will enable welding operations to be conducted indoors.

BENEFITS: Improvement in the conditions under which welding operations are conducted at TOE maintenance complexes for increased personnel safety and improved quality of work.

function

Welding to Repair Minor Repair, Structural and Subassembly Features

policy

A welding shop at the organizational level usually involves screening adequate areas at the remote end of the common use bays.

OM-6
WELDING SHOP AND BAY

issues and assumptions

1. welding types authorized
 - a. Gas, electric and gas-electric welding may be used
 - b. For electric welding, a TIGSE welding unit will be used and may be parked outdoors because of noise and engine exhaust

activities

1. Prepare materials for welding, grinding, brushing, etc.
2. Gas and arc welding of components on vehicles or removed from vehicles
3. Grind & finish welds, chip slag

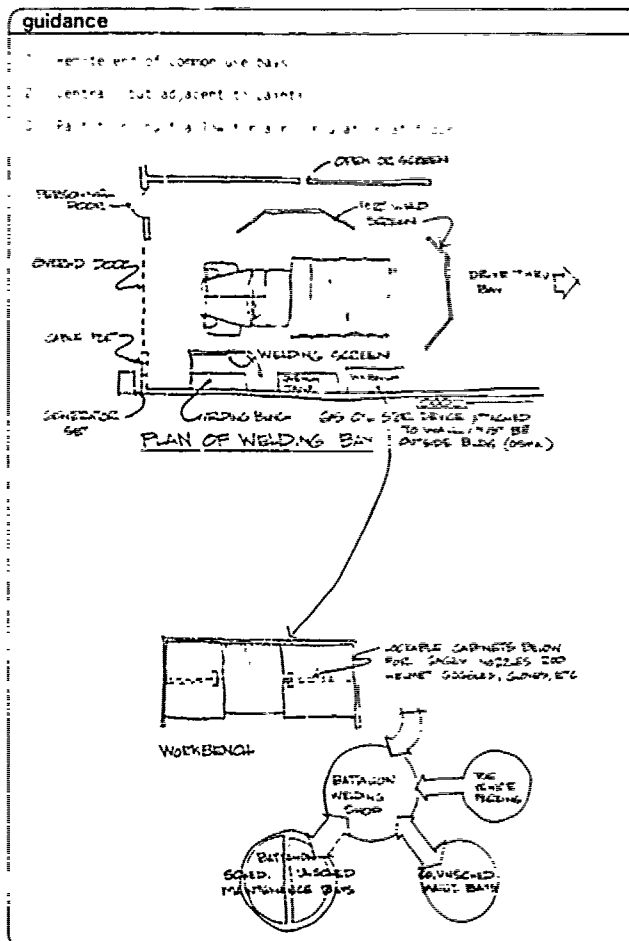
personnel

Welder per
activity

equipment

1. Gas-welding and oxygen tanks, acetylene tank, hose & torch
2. Arc welder generator unit
3. welding bench and booth
4. Supplies storage rack, rods, tools, flux
5. 3 ft x 6 ft workbench w/ vise and storage cabinet (lockable) underneath

| requirements | criteria |
|---|--|
| 1. Adequate space | 1. One or two of the small maintenance bays |
| 2. Flameproof partition or screen | 2. 8-10 ft. high |
| 3. Personnel door to outside | 3. 3 ft. x 7 ft. |
| 4. On door for vehicles | 4. 15 ft. x 18 ft. |
| 5. Access port for welding cables if electric unit is outdoors. | 5. 12 in. x 12 in. (See guidance) |
| 6. Portable light. | 6. 110V circuit. |
| 7. General ventilation or flexible local exhaust hood. | 7. If bay is confined and a) less than 10,000 cu. ft. or b) has less than a 16-ft. ceiling, or c) natural cross ventilation is not provided, a general ventilation system is required with 2000 CFM per welder. If local exhaust hood with 3-in. flange is provided, 100 FPM air flow must be provided in zone of welding (OSHA). |
| 8. Power supply for welder. | 8. 110V high current (rough in 220V for future). |
| 9. Bottle retaining device. | 9. (See guidance). |
| 10. Task lighting at benches. | 10. 50 f.c. (fluorescent fixture over bench). |



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function

Test, re-charge, fill and clean up batteries.

policy

Battery shops are authorized for units which have battery testing and charging equipment. Generally, only lead-acid batteries are charged in organizational units.

OM-7
BATTERY SHOP

issues and assumptions

activities

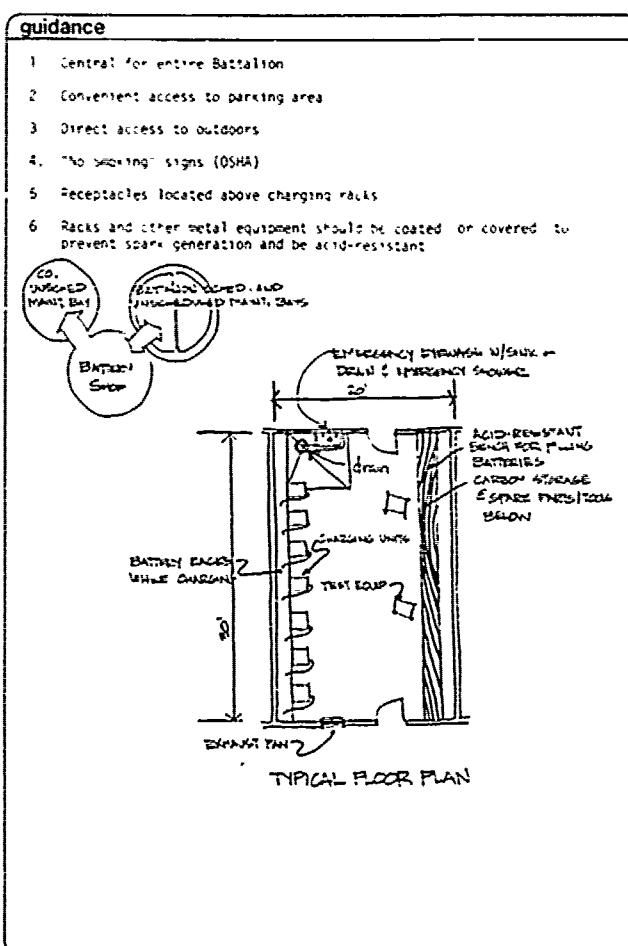
1. Remove battery from vehicle, done in parking area or outside building and bring into shop
2. Test batteries, clean battery terminals
3. Fill batteries with new electrolyte
4. Recharge batteries

personnel

equipment

1. battery charger
2. battery handling racks
3. battery charger with cable
4. jacking racks for electrolyte -- see guidance
5. battery filter unit to fill batteries
6. counter bench for filling process--corrosion resistant stainless steel surface

| requirements | criteria |
|---|---|
| 1. Adequate space. | 1. 2 or fewer chargers authorized - 300 SF 3 or more chargers authorized - 600 SF |
| 2. Power. | 2. 110V to power charger(s). Spark resisting devices for all electrical items (OSHA). |
| 3. Water. | 3. Cold water line. |
| 4. Sanitary sewer in floor. | 4. Fabricated with acid-resistant piping materials. |
| 5. Adequate lighting. | 5. 50 f.c. fluorescent or incandescent lamps in corrosion-proof fixtures. IES standard for storage rooms, active, medium. |
| 6. Thermal comfort. | 6. 65°F. (winter). |
| 7. Exhaust ventilation. Separate system to outside. | 7. 10 air changes per hour. Interlock must be provided to de-energize charging circuits if ventilation fails or is shut down. |
| 8. Sink with acid-resistant surface and faucet. | 8. - |
| 9. Emergency shower (see guidance). | 9. - |
| 10. Emergency eyewash fountain. | 10. - |
| 11. Fire extinguishers (OSHA). | 11. - |
| 12. Material-handling equipment (OSHA). | 12. Cartboy. (All motors are to be explosion-proof. All fixtures and switches are to be class II.) |



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FACILITY RECOMMENDATIONS Parts Cleaning.

BACKGROUND: Small parts cleaning (bearings, etc.) is presently performed in makeshift containers using solvents or diesel fuel which is discarded to the nearest drain when spent. These oil-bearing, dirt-laden wastes are difficult to treat when combined with other washing and maintenance cleaning wastewaters.

RECOMMENDATIONS: Provide commercial small parts cleaning equipment in TOE maintenance facilities. Equipment capable of recycling solvent until spent. Spent solutions discharge via separate collection system to centralized solvent waste storage for pickup. Collected material to be reclaimed for solvent, sold to a local reclaimer, or treated and disposed of in an environmentally acceptable manner.

IMPLICATIONS FOR THE FACILITY: Space assigned for a parts cleaning workstation and procurement of commercial small parts cleaning equipment.

BENEFITS: Control of waste discharges from small parts cleaning operations. potential recovery of solvent at the installation level. Control of the type of solvent employed in these operations. Control of exactly where these operations are performed within the maintenance complex. Increased operational efficiency of maintenance personnel.

function

Clean (small) and Moderate Sized Parts with Liquid Cleaning Agent or Solvent

policy

At both Installation and Company vehicle maintenance areas the parts removed from vehicles need to be cleaned well, whether they are to be repaired and reinstalled at the organization or packaged and sent to DS, GS or Depot level facilities.

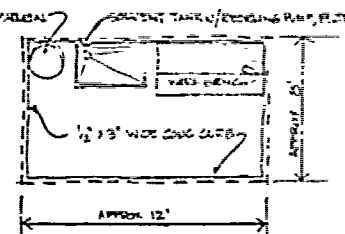
**OM-8
PARTS CLEANING**

issues and assumptions

1. Parts cleaning work station location
 - a. Both Company and Battalion vehicle maintenance units require common-use parts cleaning work stations for their individual convenient usage.

| activities | personnel | equipment |
|---|-------------|-----------------------------|
| 1. Clean parts | all members | 1. 10 gallon water bucket |
| 2. Clean parts with water | | 2. Part washer/detergent |
| 3. Clean parts exposed by disassembling | | 3. 10 gallon water bucket |
| 4. Reassemble | | 4. 10 gallon water bucket |
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| | | 71. 10 gallon water bucket |
| | | 72. 10 gallon water bucket |
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| | | 95. 10 gallon water bucket |
| | | 96. 10 gallon water bucket |
| | | 97. 10 gallon water bucket |
| | | 98. 10 gallon water bucket |
| | | 99. 10 gallon water bucket |
| | | 100. 10 gallon water bucket |

| requirements | criteria |
|---|---|
| 1. Adequate space | 1. Approx. 10 sq. ft. per operator |
| 2. Power | 2. 115V duplex outlet plus equipment connect or |
| 3. Water (for recharging solvent tank) | 3. Cold water line |
| 4. Task lighting at workbench | 4. 60" ft. |
| 5. Compressed air (at workbench location) | 5. " |

| guidance |
|--|
| <p>operator should wear eye protection and have</p> <p>isolated out of circulation path and should not be used as a</p> <p>where the solvent containers are located and the work surface</p> <p>FLOOR PLAN</p>  <p>APPROX. 12"</p> <p>3. No floor drain should be provided near the parts washer unit. Spills can be controlled on the floor surface and the solvent prevented from entering the sanitary sewer, storm sewer or waste system.</p> |

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function

Company and Battalion include Communications and Electronics Equipment Maintenance and Training and Maintenance of Fire Control Devices

policy

OM-9
COMME/FIRE CONTROL

issues and assumptions

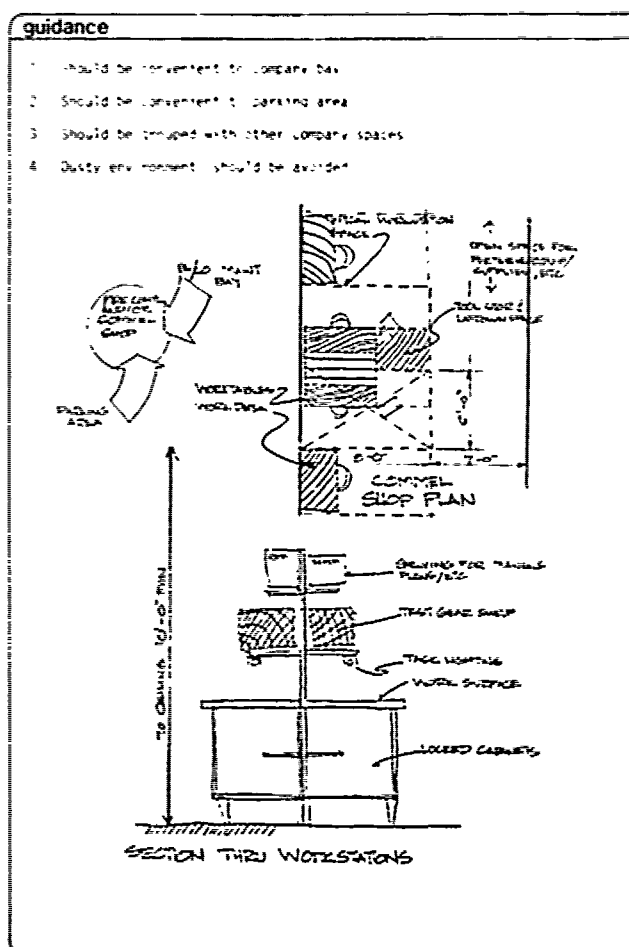
1. Fund justification:

COMPEL shops usually require special features that may not be provided under MCA funding. Justification statements will be required to release the proper fund sources.
2. COMPEL fire control space location:

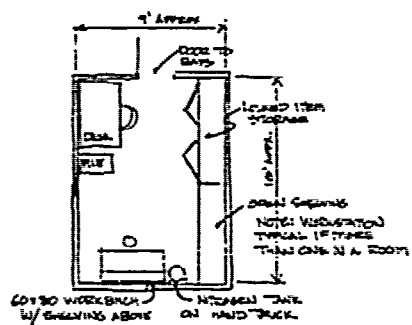
Because these functions must be concerned with cleanliness, they should be isolated from dirtier shop activities. Because COMPEL and fire control functions are similar and have similar requirements, they can be co-located. Also, space security is a factor in space location, especially for a fire control device storage.

| activities | personnel | equipment |
|---|---|---|
| <u>Company - Company Battle Position</u> | | |
| 1. Remove COMBAT equipment from vehicle and battle position area | 1 turret mechanic or equivalent | 1. 2 work benches (60 in. x 30 in.) with stools |
| 2. Bring equipment to ship | | Desk with chair |
| 3. Store equipment | | Shelving (18 in. deep for publications, 5 in. x 5 in. ft. for Bn) |
| 4. Clean equipment and forward to higher level and troubleshoot as needed | | Shelving (18 in. x 18 in. deep for storing COMBAT equipment, 5 in. x 5 in. minimum, 20 in. x 20 in. for Bn) |
| 5. Return to vehicle and install. | | 5. File cabinet - 4-drawer |
| <u>Fire Control - Company</u> | | 6. Safe file - 4-drawer |
| 1. Remove fire control device. | 1 turret mechanic or equivalent for armored, mech. infantry, artillery, engineer, air cavalry and ADA Battalions. | 1. work benches (60 in. x 30 in.) with stools |
| 2. Clean. | | 4. File cabinet - 4-drawer |
| 3. Storage for security. | | 3. Desk with chair |
| 4. Replace. | | 2. Shelving - 18 in. deep (5 in. ft. locked, 5 in. ft. open) |
| <u>Fire Control - Battalion</u> | | |
| (Same as above.) | 3 turret mechanics or equivalent | 1. 2 work benches (60 in. x 30 in.) with stools |
| | | 2. 1 or 2 desks with chair(s). |
| | | 3. File cabinet (4-drawer) |
| | | 4. Portable nitrogen bottle (for hand truck) |
| | | 5. Locked storage 18 in. deep for fire control devices (5 in. ft. to clg.) |
| | | 6. Shelves for temporary storage devices (5 in. ft. to clg.). |

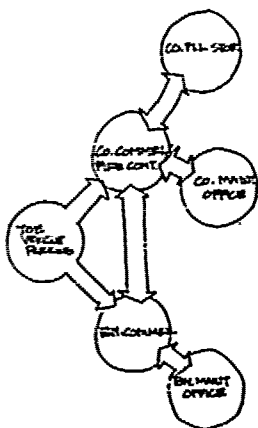
| requirements | criteria |
|--|--|
| (All COMEL, FIRE CONTROL spaces.) | |
| 1. Adequate space. | 1. Approx. 70 sq. ft. per work station, with additional 42 sq. ft. per person for open multi-use space. (See guidance.) (Approx. 90 sq. ft. for fire control.) |
| 2. Illumination | 2. 50 f.c. ambient light, with supplemental task lighting to 120 f.c. |
| 3. Power. | 3. 110V - (4 duplex outlets at each work bench). 24V (DC) special power at Battalion level COMEL space |
| 4. Lockable doors. | 4. 3 lock security system |
| 5. Roof mounted antenna. (With cable extending into COMEL room.) | 5. - |



guidance



FIRE CONTROL WORK AREA (CO. LEVEL)



OM-10
PARACHUTE SHOP

function

Parachute Inspection and Packing

policy

Issues and assumptions

1. Shop functional areas

The shop is composed of three functional areas: space for inspection, repair, and packing; 2. shake-out area; and 3. drying tower.

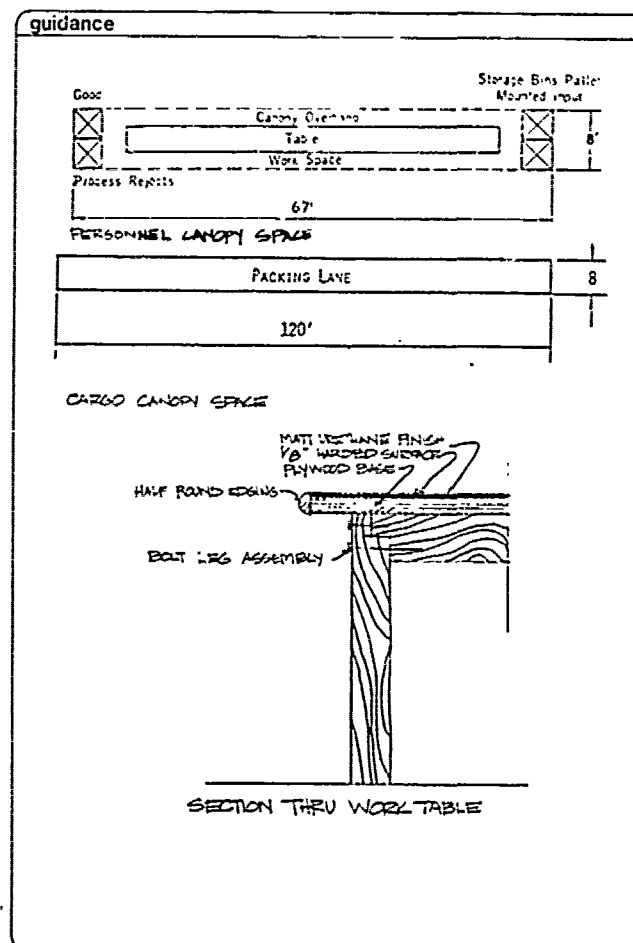
a. Area 1 is a general shop area with a ceiling clearance of about 10 ft. this area contains the long tables for folding, repair, etc.

b. Area 2 is a specialized building space with grated floor for hanging and shaking debris from the canopies; requires a ceiling height of 60-100 ft.

c. Area 3 requires a ceiling height of 60-100 ft. and special heating and ventilation equipment for humidity control.

| activities | personnel | equipment |
|-----------------------|-------------------|---------------------------------------|
| 1. Unpack to | trained personnel | Long tables, one per area |
| 2. Shaking out debris | | Rope and pulleys |
| 3. Drying | | Sewing machines on tables with chains |
| 4. Inspection | | |
| 5. Repairing | | |
| 6. Packing | | |

| requirements | criteria |
|---|--|
| 1. Adequate size | 1. TM 5-841-1 states in part: The effective number of personnel is divided by the average number of personnel expected to be assigned per personnel canopy area. The quotient is multiplied by 566 square feet, and the product is then multiplied by the layout factor to estimate the working space requirement. (See guidance.) |
| 2. Illumination. | 2. 50 f.c. fluorescent fixtures |
| 3. Power. | 3. 110V outlet each wall |
| 4. Environmental control/ventilation | 4. - |
| 5. Communications. | 5. Telephone. |
| 6. Special heating and ventilation equipment for drying | 6. - |



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FACILITY RECOMMENDATIONS: Exterior Area for Lubrication and Washing

BACKGROUND: Relevant issues addressed include the following:

(a) the general lack of facilities at existing shops for the efficient changing of oils and other fluids in tactical equipment, especially tracked equipment.

(b) the cleaning of engines, engine parts, fuel cells, motor compartments, vehicle hulls and other miscellaneous components using solvents, diesel fuels and other cleaning agents. The use of cleaning agents is primarily due to the inadequacy of the cleaning equipment furnished.

(c) difficulty of providing adequate pretreatment of waste streams generated at existing wash facilities because of high process flows, storm water intrusion from adjacent hardstand areas, and the presence of emulsifying agents used in existing operations.

See USACER, Interim Report N-67, In-Hardstand Tactical Vehicle Maintenance Facilities - Concept Design and Preliminary Recommendations for Wastewater Treatment, March 1979.

RECOMMENDATIONS: Provide facilities of this type as retrofit items to existing shops at installations where centralization of vehicle wash facilities has or will be accomplished and existing shops are not adequate to efficiently handle the maintenance requirements of the vehicles assigned to them.

IMPLICATIONS FOR THE FACILITY: Employment of the facility will allow the efficient removal of waste oils from both wheeled and tracked equipment. With the employment of the hot water washing capability provided, maintenance cleaning can be performed efficiently without the use of solvents or diesel fuels (demonstrated in testing at Ft. Lewis, WA), thereby both minimizing the quantity of process water to be treated and the levels of emulsified oils in the waste stream.

BENEFITS: Benefits to be derived from employment of a facility of this type are as follows:

- (1) operational flexibility
- (2) efficient maintenance cleaning and waste oil handling capability
- (3) minimization of process water use and therefore quantities to be treated
- (4) minimization of the quantity of emulsified oils in the waste stream and thereby minimizing the treatment costs.

function

vehicle lubrication and cleaning

policy

The routine vehicle lubrication and power part cleaning requires fast, efficient throughput in order to maintain vehicles in combat-ready condition with the limited number of personnel assigned.

OM-11
EXTERIOR LUBE AND CLEANING AREA

Issues and assumptions

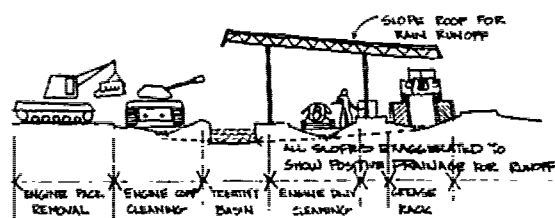
- 1. Exterior lubrication and cleaning equipment
 - a. Maintenance cleaning is handled at washtracks using low-pressure, high-water-volume wash equipment. The resulting wastes (detergents, solvents, diesel fuels, etc.) have waste treatment difficulties and expensive. High-pressure, low-volume, hot-water washers are ineffective for the rapid throughput washing of large numbers of tactical vehicles returning from field operations.
 - b. The handling of the power pak during maintenance, cleaning, and lube operations is inefficient and polluting.

Advanced Practice 1: Exterior Maintenance Facility Equipment

- a. Wastewaters generated by the low-pressure, high-volume washing of tactical equipment should be segregated from maintenance cleaning wastewater for economy of wastewater treatment. A centralized tactical vehicle wash facility should be provided for the exterior and possibly interior washing of vehicles returning from field operations. (See "Central Wash Rack" sheets.)
- b. Provision of power pak dollies for M-60 and APC tracked vehicles would significantly improve the efficiency of tracked vehicle maintenance operations and reduce oil spillage.
- c. Both hot-water washers and power-pak dolly systems should be provided at exterior maintenance bays. It is, however, desirable from a training standpoint to perform engine and pak removals with on-hand retriever equipment.

| activities | personnel | equipment |
|---|-----------|---|
| 1. Crankcase and transmission oil change 2. Engine, engine pak, and engine compartment cleaning 3. Large component parts cleaning 4. Vehicle inspection cleaning 5. Radiator flushing 6. Gun tube cleaning 7. Wheeled vehicle undercarriage washing | | Grease rack with waste oil collection funnel's wheel Cut off "S-tee" drum truck Wash hose |
| (Same as above) | | |

guidance



EXTERIOR GENERAL PURPOSE MAINT BAY

FACILITY RECOMMENDATIONS: Track Changing and Storage Area

BACKGROUND: Outdoor service area requirements are currently determined by the user based on the need to perform routine maintenance activities such as engine pak pulling, track changing, etc.

RECOMMENDATIONS: Eliminate the outdoor service area and provide an exterior track changing and storage area at the maintenance complex. A 15° solid sloped concrete ramp (syncramp) of sufficient strength to hold the heaviest tank and providing adequate field of vision should be provided at all TOE maintenance complexes servicing combat tanks.

IMPLICATIONS FOR THE FACILITY: Improved track changing and gun synchronization operations in a separate, dedicated space

BENEFITS: A track changing and storage area would provide a dedicated space for tank gun synchronization, resulting in more effective use of personnel.

function

policy

**OM-12
TRACK AND GUN AREA**

issues and assumptions

1. Interior vs. Exterior location for This Function

Currently, outdoor service areas are determined by user need to perform "routine" maintenance which includes activities such as engine pak pulling, track changing, etc. "Routine" maintenance activities other than track changing (and in some instances gun tube inspection and replacement) and sight calibration should be performed inside the maintenance building. An exterior area for track changing and tank gun synchronization should be designated within the maintenance complex because of the area required for laying out track and distances needed for target sighting during the tank gun synchronization operation.

activities

1. Track changing
 - a. Break track
 - b. Back vehicle off track
 - c. Re-pack road wheel bearings
 - d. Inspect drive sprockets
 - e. Reverse or replace drive sprockets
 - f. Replace track
 - g. Re-line,
 - h. Drive vehicle on track
2. Gun site calibration
3. Gun tube inspection (optional)
4. Gun tube replacement (optional).

personnel

3. crew members

equipment

1. Road wheel arm lifter
2. Lighted gun inspection tube (optional)
3. Wrecker with pipe (trac optional)

| requirements | criteria |
|---|---|
| 1. Hard, flat surface, adequate for withstanding tracked vehicles. | 1. Concrete. |
| 2. Adequate space. | 2. (See guidance). |
| 3. Adequate lighting to perform minor maintenance. | 3. 35 f.c. at work surface. |
| 4. Track storage area must be secured. | 4. 7 ft. high chain length fence. |
| 5. Synch ramp for tank gun synchronization having adequate field of view for target sighting. | 5. 15° solid concrete ramp sized and designed to support the entire body and weight of the heaviest combat tank and placed with adequate field of view for target sighting. |

guidance

- The area for changing track should be at least the (total) length of the longest tracked vehicle assigned to the unit plus one track length.
- This area should be at least as wide as the widest tracked vehicle.
- Ample working space around the vehicle and space for track storage should be provided.
- When the space is to be used for gun tube replacement, adequate area for maneuvering and parking a wrecker or similar vehicle at a 90° angle to the gun tube should be provided.
- A 15° ramp should be incorporated in the track changing area for tank gun synchronization.

TOE VEHICLE (Buckling)

TRUCK/ WRECKER

CO. (TRUCK) FULL

2.25' x

15° RAMP OVER ENTIRE LENGTH OF HEAVIEST GUN/TUBE

WRECKER OR SIMILAR VEHICLE

TRACK STORAGE (SHOWN IN SECTION)

15° RAMP OVER ENTIRE LENGTH OF HEAVIEST GUN/TUBE

WRECKER OR SIMILAR VEHICLE

TRACK STORAGE (SHOWN IN SECTION)

15° RAMP OVER ENTIRE LENGTH OF HEAVIEST GUN/TUBE

WRECKER OR SIMILAR VEHICLE

TRACK STORAGE (SHOWN IN SECTION)

FACILITY RECOMMENDATIONS: Centralized wash facilities for wheeled and Tracked Vehicle Washing.

BACKGROUND: Current washing practices consume substantial amounts of time, manpower and large volumes of potable water. Existing treatment systems are generally undersized and inadequately equipped and maintained to treat the volume and quality of wastewater being discharged from the facilities. Effluents from these facilities generally surpass regulatory agency guidelines set forth in NPDES permits for washrack wastewater discharges.

RECOMMENDATIONS: Remove washing operations from the separate maintenance facilities. Provide centralized wash facilities with wastewater treatment and optional recycle based on vehicle types and installation mission. Install cleaning equipment for maintenance operations in tactical equipment shops. Use high pressure, low volume washing equipment.

IMPLICATIONS FOR THE FACILITY: Scheduled use of the wash facilities may be required following major exercises. A wastewater pollution monitoring point will probably be required at each treatment facility. Operation and maintenance policy will be required for the control and upkeep of washing and treatment facilities. IG directives and local policies regarding vehicle cleanliness should be relaxed so that washing is required only for maintenance.

BENEFITS: Will improve the efficiency of the washing operation. Will reduce the amount of water required to clean the vehicles as well as eliminate the need for using polluting cleaning aids. Separation of the washing and cleaning operations would allow for more easily maintainable and cost effective treatment systems by eliminating the use of potential pollutants. Recycling of treated wastewater would reduce water utility costs at installations where water is purchased and alleviate water shortages in water-tight areas. Washing of vehicles returning from field exercises would keep dirt and debris out of the maintenance shops.

function

Tactical wheeled equipment washing.

policy

Common SOP requires that all tactical equipment be washed after field exercises.

OM-13 WHEELED VEHICLE WASHING

Issues and assumptions

1. Wastewater treatment

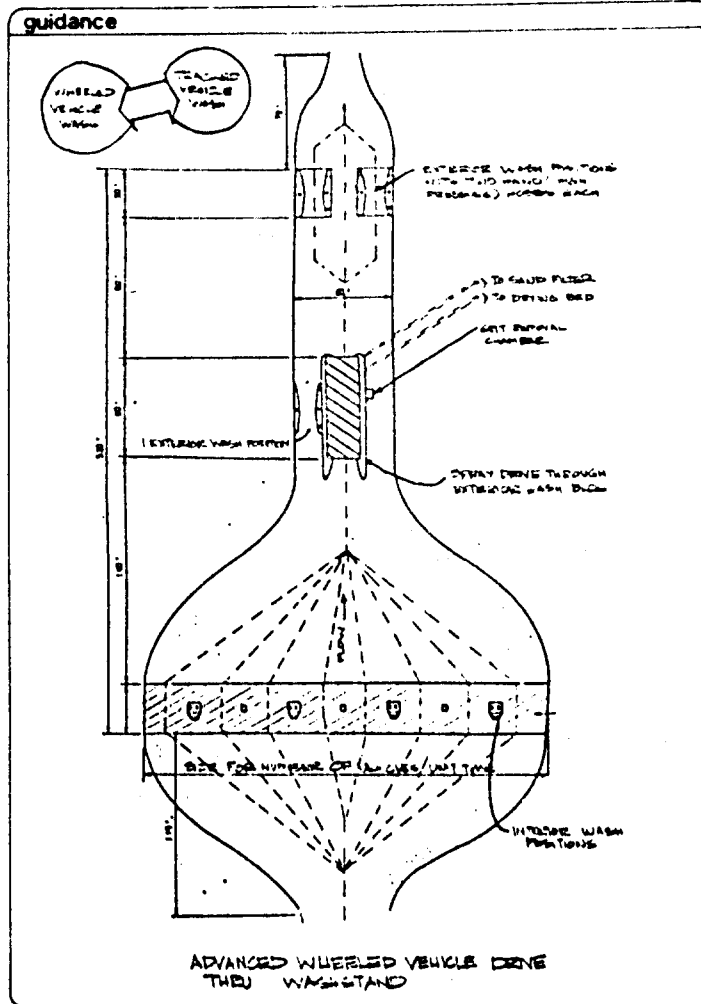
- a. Washing of wheeled tactical equipment is presently performed using high volume, low pressure washing equipment or washrack hardstands that are generally subject to storm water intrusion. The use of these areas for the cleaning of engines, engine parts, etc., using detergents, solvents, diesel fuel and other agents in these same areas further complicates the treatment of wastewaters from these areas.

Advanced Practice 1: Centralizing all vehicle exterior cleaning at one or possibly two locations will result in:

1. Reduced water usage.
2. Minimized pollution control costs.
3. Savings in manpower and energy.
4. Lessening of unit integrity.

| activities | personnel | equipment |
|--|---|--|
| <ol style="list-style-type: none"> 1. Position vehicle in washrack. 2. Prepare vehicle by removing non-soluble debris. 3. Wet down vehicle. 4. Pick out mud from treads, etc. 5. Final wash of exterior. 6. Clean personnel compartment. 7. Wash down platform. | <p>Wheeled vehicle operators (2 to 5 man-hours each vehicle).</p> | <ol style="list-style-type: none"> 1. Hose with nozzle. 2. Misc. cleaning tools. 3. Pumps to maintain water pressure at all stations at once. 4. Oil/water separation unit. |
| | <p>Wheeled vehicle operators (1/2 to 1 man-hours each vehicle).</p> | <ol style="list-style-type: none"> 1. Commercially available truck washing drive-through unit specifically designed to accommodate Army wheeled tactical equipment. (See guidance.) 2. Hand-held high pressure, low volume wash equipment for the washing of jeeps, equipment that has broken down in the field and certain engineer wheeled construction equipment. 3. Low pressure, low volume hand-held hoses at interior cleaning stalls. 4. Solid waste containers at all interior cleaning stalls. |

| requirements | criteria |
|---|---|
| 1. Cold water supply (potable) with booster pump. | 1. Volume: 30 gal./min. hose with pressure: 70 to 100 psi. |
| 2. Hardstand area. | 2. Reinforced concrete pad, 30 ft. x 20 ft. min. vehicle wash station. |
| 3. Hose delivery system. | 3. Flexible 1- to 2-in. 20- to 30-ft.-long hose with nozzle from overhead (20-ft.-high) frame. |
| 4. Drainage trench. | 4. 36 in. wide, 12 in. deep leading to oil separation unit. |
| 5. Wastewater treatment system. | 5. For EPA std. specifications. |
| 1. Non-potable water supply. | 1. Pressure: 100 psi at nozzle. Volume: 20 gal./min. (2 to 4 gal./min. for interior cleaning). |
| 2. Hardstand, paved area. | 2. (Same as above.) |
| 3. Hose delivery system. | 3. Flexible, reinforced hose with nozzle. a. One low pressure, low volume wash hose per vehicle for interior cleaning. b. Two high pressure, low volume wash hoses per vehicle for all supplemental exterior wash bays. |
| 4. Enclosed all-weather washing facility for exterior cleaning. | 4. Equipment to provide complete exterior surface and undercarriage washing of virtually all Army wheeled tactical equipment. |



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FACILITY RECOMMENDATIONS Centralized wash facilities for wheeled and tracked vehicle washing.

BACKGROUND: Current washing practices consume substantial amounts of time, manpower and large volumes of potable water. Existing treatment systems are generally undersized and inadequately equipped and maintained to treat the volume and quality of wastewater being discharged from the facilities. Effluents from these facilities generally surpass regulatory agency guidelines set forth in NPDES permits for washrack wastewater discharges.

RECOMMENDATIONS: Remove washing operations from the separate maintenance facilities. Provide centralized wash facilities with wastewater treatment and optional recycle based on vehicle types and installation mission. Install cleaning equipment for maintenance operations in tactical equipment shops. Use high pressure, low volume washing equipment.

IMPLICATIONS FOR THE FACILITY: Scheduled use of the wash facilities may be required following major exercises. A wastewater pollution monitoring point will probably be required at each treatment facility. Operation and maintenance policy will be required for the control and upkeep of washing and treatment facilities. IG directives and local policies regarding vehicle cleanliness should be relaxed so that washing is required only for maintenance.

BENEFITS: Will improve the efficiency of the washing operation. Will reduce the amount of water required to clean the vehicles as well as eliminate the need for using polluting cleaning aids. Separation of the washing and cleaning operations would allow for more easily maintainable and cost effective treatment systems by eliminating the use of potential pollutants. Recycling of treated wastewater would reduce water utility costs at installations where water is purchased and alleviate water shortages in water-tight areas. Washing of vehicles returning from field exercises would keep dirt and debris out of the maintenance shops.

OM-14 TRACKED VEHICLE WASHING

function

policy

Issues and assumptions

Common practice now requires that exterior, interior, and miscellaneous cleaning activities all occur on the washrack. The two major problems associated with this practice are:

1. Washing process uses large volumes of potable water and great amounts of manpower and time.
2. Process presently requires large volumes of polluting cleaning aids which must then be removed from wastewater.

However, to preserve unit integrity, dispersed wash sites may be acceptable.

Advanced Practice 1: Centralizing all vehicle exterior cleaning at one or possibly two locations will result in:

1. Reduced water usage.
2. Minimized pollution control costs.
3. Savings in manpower and energy.
4. Lessening of unit integrity.

Advanced Practice 2: Creating a pre-soak area for tanks would result in:

1. Reduced water usage.
2. Less time on wash stand.
3. Less manpower needed for washing.

| activities | personnel | equipment |
|--|---------------------------|---|
| <ol style="list-style-type: none"> 1. Position vehicle in washrack 2. Prepare vehicle by removing nonwashable debris 3. Wet down vehicle 4. Pick out mud 5. Final wash of exterior 6. Clear engine compartment 7. Clean pers. compartment 8. Wash platform | 1 to 3 man-hours est. | Hose with nozzle Misc. cleaning aids Pumps Drainage Oil/water separation |
| <ol style="list-style-type: none"> 1. Vehicle staging 2. Vehicle pre-wash 3a. Vehicle bath. 3b. Wash I 4. Wash II 5. Vehicle assembly | 1 1/2 man-hours est. max. | <u>Washing Function</u> Hoses and nozzles Booster pumps Lighting Trash bins |
| <ol style="list-style-type: none"> 1. Drive tank through bath. | | Storm water in conc. bath. |

requirements

1. Cold water supply (potable) with booster pump.
2. Hardstand area.
3. Hose delivery system.
4. Drainage trench.
5. Wastewater treatment system.

criteria

1. Volume: 30 gal./min. hose with pressure: 70 to 100 psi.
2. Reinforced concrete pad, 30 ft. x 40 ft. min. vehicle wash station.
3. Flexible 1- to 2-in. 20- to 30-ft.-long hose with nozzle from overhead (20-ft.-high) frame.
4. 36 in. wide, 12 in. deep leading to oil separation unit.
5. for EPA std. specifications.

1. Non-potable water supply.

2. Hardstand.
3. Pump house.
4. Paved area.

5. wastewater treatment systems.

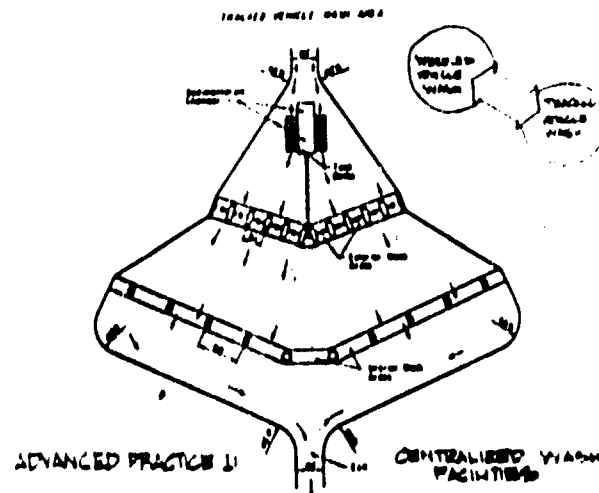
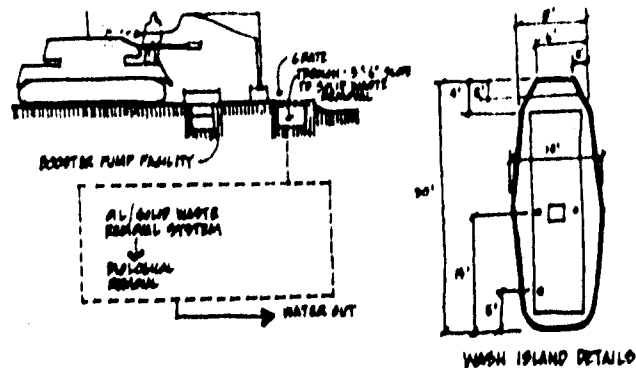
1. Pressure: 100 psi at nozzle. Volume: 20 gal./min. (2 to 4 gal./min. for interior cleaning).

2. (Same as above.)
3. Flexible, reinforced hose with nozzle.

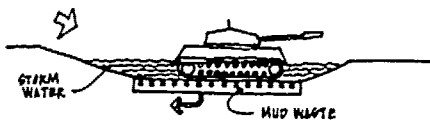
1. Water containment area large enough to hold an M1 tank and long enough for one rotation of track under water.

1. 80 ft., 0 in. long. 12 ft., 0 in. wide.
2. Conc. 12-in. reinf. to support 40 tons distributed loading.

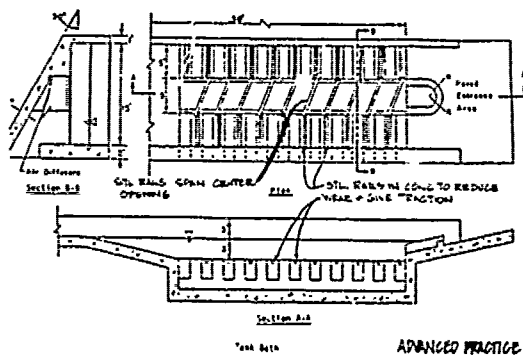
guidance



guidance



ADVANCED PRACTICE 2 : PRE-NASH TANK BATH



ADVANCED PRACTICE 2

FACILITY RECOMMENDATIONS Maintenance Operations Administration Area

BACKGROUND: At many maintenance facilities, offices for supervisory personnel are located on the ground floor, behind latrines, storage areas, shops, etc., secluded from the maintenance bays. At some facilities the space above the offices, latrines, etc., is used for storage.

RECOMMENDATIONS: Offices for supervisory and administrative personnel should be located on the second floor. Windows should be positioned so that supervisory personnel can observe activities in the maintenance bays and parking areas.

IMPLICATIONS FOR THE FACILITY: The second floor position provides secluded office space but allows supervisory personnel to observe maintenance activities. It also provides more space for storage and shops on the ground floor.

BENEFITS: Positioning office spaces on the second floor is a better utilization of the lower level space. An overview of the maintenance activities will provide management better opportunities to optimize personnel effectiveness.

function

Administration of Maintenance Operations

policy

Administrative tasks for supply and equipment control are required independently in each Company and Battalion.

OM-15
MAINTENANCE OFFICE

Issues and assumptions

1. Location of administrative areas:

All administrative spaces are located contiguous with the spaces they support.

2. Dispatching control location:

The Battalion should control dispatching if only one Battalion is located in the compound. If more than one Battalion is located on the compound, dispatching should be located in the bays. (See space 24: "Sentry/Dispatch".)

3. Extent of reference manuals:

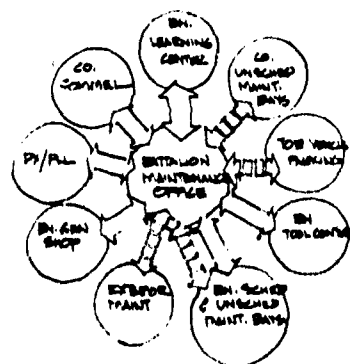
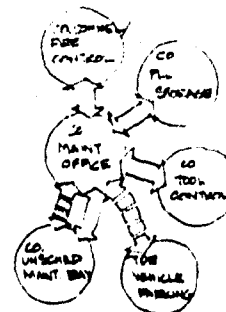
Each Co. and Bn. needs a reference library for deployment. The Bn. will have a much larger amount of reference material.

| activities | personnel | equipment |
|----------------------------------|-------------------------------------|---|
| 1. Supervision/control. | Battalion | 1. 4 desks w/chairs. |
| 2. Records keeping. | 1 - Maintenance officer. | 2. 1 files - 4-drawer. |
| 3. Job order processing. | 1 - warrant officer. | 3. 2 cabinets, 18 in. x 48 in. x 60 in. high. |
| 4. Library of reference manuals. | 1 - Motor sergeant. | 4. 2 book cases - 15 in. x 120 in. x 72 in. high. |
| | 1 - Receiving clerk. | |
| | Company | |
| | 1 Motor sergeant. | 1. 2 desks w/chairs. |
| | 1 Receiving clerk. | 2. 2 files - 4-drawer. |
| | 1 Motor officer (absent from area). | 3. 1 cabinet, 18 in. x 48 in. x 60 in. high. |
| | | 4. 2 book cases - 15 in. x 48 in. x 72 in. high. |

| requirements | criteria |
|-----------------------------------|--|
| 1. Adequate space. | 1. 80-90 sq. ft. per person with additional space for equipment and files. |
| 2. Power. | 2. 110V duplex outlets each 10 ft. of wall. |
| 3. Lighting. | 3. 50 f.c. w/fluorescent fixtures. |
| 4. Heating, cooling, ventilation. | 4. Winter: 68° F.; Summer: 78° F.D.B. where air conditioning is authorized by DOD 4270.1M; 65° F.W.B.; 50% minimum R.H. ventilation - 10 CFM per person. |
| 5. Communication. | 5. Coordinate telephone and intercom needs with the installation. |

guidance

- The supervisory personnel need to be able to observe the work areas (bays; TOE parking). Preferably the admin. office space should be located on the second floor with windows in all walls.



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function

Storage of Floor Dry, Clean and Dirty Shop Towels.
(Janitor's Closet)

policy

OM-16
MAINTENANCE SUPPLY AREA

issues and assumptions

activities

personnel

equipment

1. Receiving.
2. Inspection.
3. Placement.
4. Storage/inventory.
5. Dispensing.

None.

1. Shelves.
2. Containers with lids
(clean 55-gal. drums).
3. Service sink.
4. Hooks.

| requirements | criteria |
|---------------------------|--|
| 1. Adequate size. | 1. Minimum space to accommodate requirements based on size and number of items to be stored. |
| 2. Illumination. | 2. 15 f.c. (use incandescent fixtures). |
| 3. Plumbing. | 3. Provide service sink. |
| 4. Environmental control. | 4. Winter: 60°F; ventilation: 2 CMF per sq. ft. |

| guidance |
|--|
| <p>Location: Should be central to common use areas of the facility, and have access to general circulation near the tool room and lavatory.</p> <p>Clean towels can be dispensed through the tool room.</p> <p>The floor drying compound and the dirty towel containers should be located outside the tool room.</p> <p>Brooms, mops, cleaning supplies, and the like should be located in the Janitor's Closet.</p> |

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FACILITY RECOMMENDATIONS: Tool Control, Tool Box and Bench Stock Storage

BACKGROUND: Presently, there is no allocation of space to lock up tool boxes if there are less than six people assigned to the unit. If there are six or more people assigned to the unit, 24 square feet is authorized per person.

RECOMMENDATIONS: Establish and authorize adequate storage space to secure tool boxes, bench stock, and the like for all units at maintenance facilities. The allocated size of the space should be based on the size and number of items and the number of personnel assigned to the unit. The tools, bench stock, and the like assigned to the unit depends on the vehicles and equipment the unit maintains. (Carts may be used to secure tools.)

IMPLICATIONS FOR THE FACILITY: The space authorized each Company, a room or cart(s), would be adequate to secure the tools. If carts are authorized, they could be secured in the Battalion tool room and would be ready for deployment and/or daily use.

BENEFITS: Increases control of tools and bench stock. Alleviates or eliminates loss of tools and bench stock. Provides for a more efficient use of tools and supplies.

function

Tool Control
Tool Box Storage
Bench Stock
Tool Control

policy

The tool box storage area is general shop space in which contact team personnel can store their tools and miscellaneous items when not in use.

Provide administrative space for a tool control clerk in Company tool rooms and always in the Battalion or headquarters Company tool room.

OM-17 TOOL CONTROL

issues and assumptions

1. Determination of area required:

Five people or less need space to secure their tool boxes. A minimum space should always be allocated to secure tool boxes. The space allocation should be based on the size and number of tools and tool boxes, not just on the number of personnel.

Advanced Practice 1: Personnel will always need a place to lock up their tools. The number and size of the tools and the number of tool boxes will depend on the type of vehicles being maintained and the number of personnel assigned to the maintenance function.

activities

1. Receiving.
2. Inspection/inventory.
3. Storage/placement.
4. Issuing (check-out).

(Same as above.)

personnel

equipment

1. Desk with file.
2. File - 4-drawer.
3. Chalkboard, 1 ft. x 4 ft.
4. Locked cabinet, 14 in. x 38 in. x 12 in. high.
5. Peg-boards (40 in. x 96 in.).
6. Cabinet with small drawers.
7. Bench with shelf.

(Same as above.)

| requirements | criteria |
|--|--|
| <ol style="list-style-type: none"> 1. Adequate size. 2. Illumination. 3. Dutch door, to dispense tools. 4. Communications. 5. Power - coordinate power needs with user service. | <ol style="list-style-type: none"> 1. Less than six - no space allocation. Six or more - 24 square feet per person. 2. 40 f.c. - fluorescent light fixtures. 3. 3 ft. door. 4. Telephone. 5. 110V outlet each wall. |
| <ol style="list-style-type: none"> 1. Adequate size. | <ol style="list-style-type: none"> 1. A minimum size should be determined and specified based on number and size of tools, bench stock, tool boxes and the like assigned to the unit, determined by the vehicles maintained. |

guidance

1. Each Company needs access to the Battalion tool room. The Bn. has more tools, some of which the Company uses but does not have authorized to them.
2. Each person (or 2-3 people) could have a cart similar to the sketch or the Company could have a large cart or two where tool boxes could be secured. The cart could be loaded for deployment. (It might be possible to provide enough space on 1 or 2 carts to keep some supplies and PLL items.)
3. The carts could also be secured in the Bn. tool room, ready for deployment or daily use.

TOOL CART DESIGN PER EACH COMPANY

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FACILITY RECOMMENDATIONS: Direct Exchange (DX)/Prescribed Load List (PLL) Management and Storage Area

BACKGROUND: Most PLL items are stored on company trailers ready for deployment. Few units have a PLL clerk authorized; most often the responsibility for the storage and control of the PLL items is one of many responsibilities assigned to a clerk. Control of PLL items may be either at the Battalion or Company level.

RECOMMENDATIONS: A computerized inventory should be established with a terminal for each Battalion at the organizational level with a PLL clerk authorized per Company. Co-locate the PLL at the Battalion level.

IMPLICATIONS FOR THE FACILITY: A computerized inventory system with interactive terminals would allow an organization to immediately order a part as it is issued for use. A "full-time" PLL clerk at the company level could issue and order parts as they are needed. The co-location of PLL at the Battalion level would allow for better communication of PLL clerks, cross-leveling of parts, and the like.

BENEFITS: The computerized inventory would keep the stock of PLL parts more current and up-to-date, ready for deployment, since the replacement part would be ordered immediately. The paper workload would be alleviated or eliminated, providing for a more efficient and effective operation.

A "full-time" PLL clerk can dispense parts when the mechanics need them, increasing the time a mechanic has to work on equipment, rather than waiting for parts to be issued.

The co-location of the PLL will allow the clerks to fill in for one another if one is sick or has other duties. It will also provide for cross-leveling of parts and keep every Company better prepared for deployment.

**OM-18
DX/PLL**

function

Direct Exchange (DX)/Prescribed Load List (PLL) Management and Storage of Parts

policy

1. PLL storage is the space required to store and administer a directed list of parts commonly used in organizational and direct support units, and taken with those units when they are deployed.
2. In organizational units, items may be stored either by Company or by Battalion; generally, storage by Battalion is preferred.
3. DX/TS (Technical Supply) consists of a customer service area, catalog area, and bin storage area for the receipt of unserviceable parts and issue of replacement parts and components. (DX/TS occurs in direct support units and in some large organizational TOE units such as combat engineers.)
4. The extent of PLL parts will vary from unit to unit depending on the type and number of vehicles assigned to the unit, not necessarily related to the number of unit personnel (as indicated in TM 841-1, page 2-35); therefore space needs should be considered for each facility based upon the policy at the unit.

issues and assumptions

1. Effectiveness of PLL stock location:

PLL storage is normally located with other supplies and equipment adjacent to the common use vehicle bays when PLL is stored in common. Access to outside or common circulation is required to give all companies access. (The PLL allocation may also be split among the companies and located concurrently with their supply and equipment areas for more "Unit Integrity".) Also, current practice is to locate the PLL storage at one end of the facility. (This saves the construction of one wall.) However, to locate the PLL and supply storage in the center of the building provides for a more efficient and effective day-to-day operation at the facility, especially where PLL is at the Battalion level, located on vans or trailers for deployment purposes secured by company lock. (No PLL clerk is authorized; one clerk may have several areas of responsibility.)

Advanced Practice 1: Computerized inventory, as an item is issued from storage. The clerk punches in the item, and the replacement part is automatically ordered.

Advanced Practice 2: Need one authorized PLL and records clerk per company.

activities

1. Receiving.
2. Inspection/inventory.
3. Placement/shelving.
4. Dispensing.

personnel

1. PLL clerk (when one is assigned by TOE.)

equipment

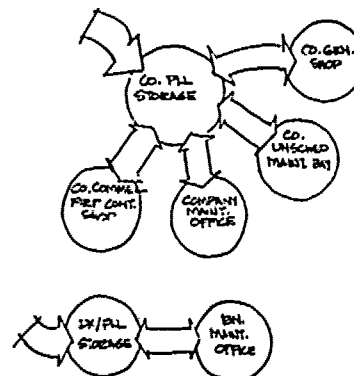
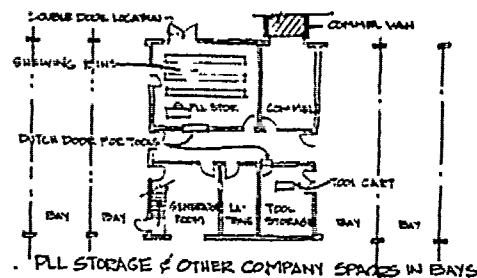
1. Desk with chair (table required if desk and chair are at other location).
2. File cabinet - 5-drawer.
3. Parts, bins, shelving.
4. Additional equipment may be needed to move parts and position them in the storage area, and to dispense them. Also, containers may be needed to pack parts for deployment.
5. Microfiche viewer.

1. An installation computer system with remote terminals at each maintenance facility.

| requirements | criteria |
|--|---|
| 1. Room sized for extent of PLL required. | 1. TM 5-841-1 states: "The PLL storage area space requirement is estimated by multiplying the total number of facility personnel by 2 square feet." Total D/I/TS storage space is estimated by multiplying the total number of personnel assigned to the area by 100 sq. ft. |
| 2. Environmental control. | 2. Winter - 65°F. |
| 3. Illumination. | 3. 40 f.c. at vertical shelving. |
| 4. Check-out window. | 4. 3 ft. x 3 ft. area--may be as dutch-door (accessible to/from bays). |
| 5. Double doors, located on an exterior wall (or to a maintenance bay) for movement of parts into and out of the building. | 5. 6 ft. opening width. |
| 6. Adjustable loading dock. | 6. 3 ft., 10 in. at receiving/issuing points. |
| 7. Communication. | 7. Telephone |
| 1. Telephone line. | 1 - |
| 2. Electricity. | 2. 110V, 15A duplex recept. |

guidance

1. The Company trailers containing the PLL should be located near the PLL control clerk for the Battalion.
2. If Companies have PLL, PLL will not be needed at the Battalion level. DX will be at the Battalion level; HQ CO will supply BN with parts if the PLL is kept at the Company level.
3. Co-locate PLL w/ Battalion maintenance, for best results, cross-level parts, etc.



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FACILITY RECOMMENDATIONS Personnel Training and Work Break Activity Space

BACKGROUND: At many maintenance facilities there are no break areas provided; a vending machine might be placed in a hallway, or bay. At most maintenance facilities there are no training rooms within the maintenance facility.

RECOMMENDATIONS: It is recommended that a break/training room, larger than 100 sq. ft., be established in each maintenance building; that each break/training room be equipped with a drinking fountain and AV equipment; and that each maintenance facility have a break/training room at least 15 ft. x 15 ft. (225 sq. ft.). [100 sq. ft., as provided by TM 5-341-1 for 50 people, is not sufficient for training or conferences.]

IMPLICATIONS FOR THE FACILITY: By establishing a break area with vending machines, personnel could get out of the bays where work is being performed. They would not have to go to vending trucks, private vehicles, post exchanges or the like for a break. In a similar manner, if a training room is established in the maintenance facility, personnel may be given instructions and receive training away from the work areas.

BENEFITS. Personnel will spend less time traveling to and from break areas or classrooms at other buildings and more time at the maintenance facility. Breaks, training conferences, and the like can occur without interfering with working personnel or vice versa.

function

Personnel Training and Work Break Activities

Policy

A break, training, and conference area should be provided at a central location in the building where persons can assemble for daily work breaks and periodic group training sessions.

OM-19 CLASSROOM/BREAK AREA

issues and assumptions

Advanced Practice 1: Adequate Space (Area) for Breaks, Training, and/or Conferences

Most facilities have fixed-wall construction on interior walls. Movable walls would allow for flexibility in space allocation. It is difficult to plan adequate space for breaks, training, and conferences at maintenance facilities, because the number of personnel assigned to the facility varies from year to year and depends on several factors. Also there should be a "minimum-size" space greater than the 100 sq. ft. now allowed in TM 5-841-1.

activities

1. Training classes
2. Breaks
3. Conferences

personnel

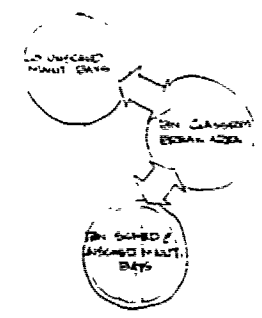
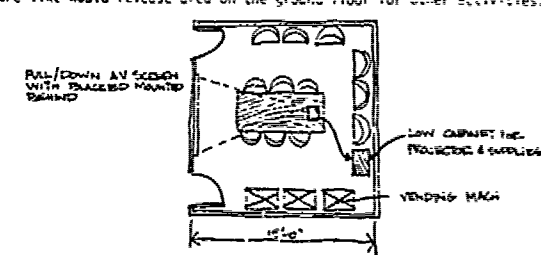
Could be all the personnel that work in the building, probably in groups of 20 percent of assigned maximum

equipment

1. Tables with side chairs
2. vending machines
3. Drinking fountain

A minimum should be established, such as 1 table and 6 chairs, drinking fountain.

| requirements | criteria |
|--|---|
| 1. Adequate size. | 1. Determined by TM 5-841-1 "Divide total number of facility personnel by 50. The decimal portion of the result is dropped and the remaining whole number is multiplied by 100 square feet." |
| 2. Smoking area ventilation (must be physically separated from vehicle bays). | 2. Ventilation - 10 CFM per person. |
| 3. Power. | 3. Provide one 120V-20A duplex receptacle for each vending machine. Minimum of 1 each wall. |
| 4. Water sources for drinking fountain and coffee machines. | 4. - |
| 5. Illumination. | 5. 60 f.c., fluorescent ceiling fixtures, with one fixture at rear of space switched separately for minimum light level for AV presentations. |
| 6. Communication. | 6. 1 wall telephone. |
| 7. AV screen. | 7. 8 ft. x 8 ft. pull-down screen. |
| 1. A minimum size should be established, no matter how many people are assigned to work at the facility. | 1. The minimum size should provide enough space to accommodate training, break, and/or conference activities. (If there are 50 people assigned to the facility, TM 5-841-1 provides for 100 sq. ft. or a room 10 ft. x 10 ft. This is inadequate for breaks, training, or a conference involving more than 3 people.) |

| guidance |
|--|
| <p>Break areas should be centrally located on the ground or second floor of the building, with access provided to the general circulation corridor and stairs.</p>  |
| <p>1. Example: A room 15 ft. x 15 ft. (225 sq. ft.) will provide adequate space for a table and 6 chairs, plus some standing room or space for vending machines and adequate distance for AV presentations.</p> <p>2. The use of second floor space for office area, conference rooms, and the like would release area on the ground floor for other activities.</p>  |

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FACILITY RECOMMENDATIONS: Learning Center - to help keep maintenance personnel current on repair procedures and to refresh knowledge.

BACKGROUND: Maintenance personnel need to periodically read information regarding repair procedures. At the present time, there are no provisions for a quiet, isolated area within the maintenance facility where one or two people may read. Most viewers and files are located in the PUL storage/supply area.

RECOMMENDATIONS: A small room should be established in each maintenance facility with one or two table(s) and chair(s) and a cassette viewer(s) and file(s).

IMPLICATIONS FOR THE FACILITY: Personnel could use an isolated learning center so they are not distracted by other activities. Supervisory personnel may also use the center to discuss repair procedures and the like with one or two people and not tie up the break/training area.

BENEFITS: Since there will be fewer distractions, personnel should be able to read and learn the information faster. Consequently, they should have more time to devote to work and will be better prepared to execute it.

function

To help keep Maintenance Personnel Current on Repair Procedures and to Refresh Knowledge

policy

Training aids are available for most maintenance operations. It is important for all personnel to use them periodically to learn of new maintenance equipment and practices.

OM-20 LEARNING CENTER

issues and assumptions

activities

1. A-V cassette viewing
2. Reading

personnel

- 2 (at a time)

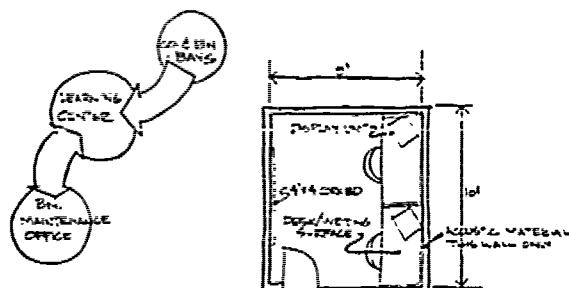
equipment

1. 2 tables or carrel units (24 in. x 48 in. w. chairs)
2. 2 audio-video cassette viewers (Bessler-30 carrels)
3. Cassette files

| requirements | criteria |
|---|-------------------------------------|
| 1. Adequate space. | 1. Approx. 80 sq.ft. (See guidance) |
| 2. Illumination. | 2. 70 f.c. (fluorescent fixtures). |
| 3. Electricity. | 3. 110V duplex outlet each. |
| 4. Environmental control and ventilation. | 4. 58°F. (winter). |

guidance

1. Set up a small room at the Bettelton level in an isolated area. One or two persons at a time will use the room.
2. The cassettes are normally maintained at the learning center.
3. The learning center could be located in an isolated area near the break area classroom.



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FACILITY RECOMMENDATIONS: Latrines

BACKGROUND: In some locations, reducing water consumption is important, because supplies are dwindling and costs are increasing. As energy costs increase, the costs for water supply and wastewater treatment will increase at all installations.

RECOMMENDATIONS: Install water-saving devices in latrines.

IMPLICATIONS FOR THE FACILITY: There are a number of different types of water-saving devices produced by the commercial manufacturers that can be installed in water closets, faucets, and showers without affecting the use of the equipment.

BENEFITS: Reduces water consumption and water supply costs and reduces wastewater treatment costs.

function

Latrines for Facility Personnel Use

policy

Toilet facilities shall be provided for men and women in accordance with ODC 4270.1M.

**OM-21
LATRINE**

issues and assumptions

1. Space Allocation:

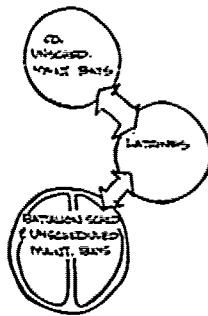
The size of the latrine should be based on the number of wash basins, water closets, and urinals needed to accommodate the number of people assigned to the facility to provide adequate facilities and reduce waiting time.

2. Water Consumption:

In some locations, reducing water consumption is important. On military facilities, the installation of water-saving devices in latrines would reduce the amount of water that is used without affecting the operation of the equipment. This is especially important in geographic areas where water supplies are dwindling; in addition, it reduces water supply costs at all military installations.

| activities | personnel | equipment |
|---------------------|--|---|
| 1. Washing | All the personnel assigned to the facility, visitors | 1. Wash basins, soap holders |
| 2. Eliminating | | 2. Showers, need spec. of justification |
| 3. Self-cleaning | | 3. Urinals, water closets |
| 4. Personal storage | | 4. Mirrors |
| | | 5. Paper towel holders |
| | | 6. Lockers, benches |
| | | 7. wastebaskets |

| requirements | criteria |
|--------------------------|---|
| 1. Illumination. | 1. 25 f.c. |
| 2. Power. | 2. 110V at least 24 in. above finished floor: (1, 2GA duplex/wall). |
| 3. Plumbing fixtures. | 3. Provide water closets, urinals, and wash basins in accordance with 900 4270.1M. Install water-saving devices in water closets, faucets, and showers. |
| 4. Temperature. | 4. Winter - 58°F. |
| 5. Adequate ventilation. | 5. 2 CFM/sq. ft. |
| 6. Adequate size. | 6. 10 or fewer facility personnel - use 38 sq. ft. per person. More than 10 - total number of facility personnel is divided by 10, and the decimal portion of the result is dropped. The remaining whole number is multiplied by 38 sq. ft., and the result is multiplied by the facility layout factor (TM 5-841-1). |

| guidance |
|--|
| <ol style="list-style-type: none"> 1. Use fluorescent fixtures for lighting. 2. Latrines should be centrally located and accessible from exterior and interior work areas. 3. Latrines should be provided in each inhabited building within a complex. 4. Latrines should be located in the parts of the building constructed as shop or office space. <p>There are a number of different types of water-saving devices produced by commercial manufacturers that can be installed in water closets, faucets, and showers.</p>  |

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FACILITY RECOMMENDATIONS: Flammable Storage (POL)

BACKGROUND: For every module of 25 organizational vehicles, 60 sq. ft. of exterior, covered storage is allocated for storage of oil, lubricants, flammable solvents, and paint. The area must be at least 50 ft. from any building. Products are generally stored in 55-gal. drums but may be stored in smaller containers depending on the type of product.

The types, quantities, and handling characteristics of various products needed to satisfy requirements peculiar to the unit vehicle types are not considered in storage area determinations. Storage areas are frequently used as product dispensing or transfer stations. Drums in the storage area are topped for the quantity of product required for a specific activity such as oil changes or additions. Several product transfers from the storage area to the maintenance location may be involved to perform a single activity. Spillage and inattentiveness contribute to oil contamination of both the storage and work areas which lead to pollution and safety problems.

RECOMMENDATIONS: Flammable storage area (POL) allocations should be determined by the total volume of specific products required to perform routine maintenance activities for each vehicle type assigned to the organizational unit in accordance with maintenance schedules and practices. Based upon the quantities, bulk storage and dispensing systems should be incorporated in all maintenance facilities for commonly used POL, antifreeze, etc.

IMPLICATIONS FOR THE FACILITY: A flammable (POL) storage area for POL product rotation will be required for department use only.

Bulk storage may create policy implications regarding the purchase of both new and refiltered products, distribution (logistics) and quality control of bulk materials.

BENEFITS: Bulk storage and product dispensing systems would:

- (1) Eliminate current inefficiencies in fluid transfers which contribute to facility pollution problems related to oil and other hazardous substances in stormwater.
- (2) Conserve both time and energy by eliminating numerous product transfers and minimizing product waste.
- (3) Reduce vehicle maintenance process times for fluids checks, additions and changes.
- (4) Improve personnel safety related to current inefficient handling of hazardous products.

function

This Space is used for Storage of Flammable Materials Required by the Organizational Unit Occupying the Complex

policy

A fenced and roofed area is required for the storage of oil, lubricants, flammable solvents, and paint.

OM-22
POL STORAGE

Issues and assumptions

1. Determination of POL storage area:

Area allocation for POL storage facilities is presently based on the number of vehicles assigned to the organizational unit only. Other factors as well as vehicle numbers which should be considered in determining POL storage requirements are vehicle types and the number and diversity of vehicles in each unit.

Storage area requirements would be more reasonably based on consideration of the volumes and types of products required to service vehicles within the unit. The crankcases of most wheeled vehicle engines, for example, contain less than 7 qt. of oil, whereas those of many tracked vehicles contain 40 or more. A unit composed primarily of wheeled vehicles would have less of a requirement for storage than one of mostly tracked vehicles.

2. POL pollution at storage locations:

POL storage areas are frequently used as product-dispensing or transfer stations. Drums of product are tapped for the quantity of product required for an activity such as oil changes or additions. Transfer operations are frequently inconvenient at best. Spillage and inattention contribute to oil contamination of storage and vehicle work areas. The "storage" area, in practice, becomes a work area.

Provisions for dispensing fluids from bulk storage containers would improve efficiency of transfer operations in terms of manpower and product waste. Product loss reductions would help to reduce pollution control problems related to oil and other products in stormwater.

Advanced Practice 1: Bulk Fluids Storage and Dispensing

Current practice involves numerous transfers of POL products in moving products from the storage area to the maintenance location (building or exterior locations). These transfers involve substantial duplication of effort by users and loss of product. Apparently, procurement policy prevents organizational units from obtaining frequently used products in bulk form for storage in large reservoirs and dispensing them as they do fuels.

Bulk storage and dispensing systems for commonly used POL and other products (i.e., antifreeze) would eliminate current inefficiencies in fluid transfers. Such systems would also reduce POL (flammable) storage requirements.

REFERENCE: Vehicle Maintenance Bays: closed waste and new oil transfer system.

| activities | personnel | equipment |
|---|----------------|--|
| <ol style="list-style-type: none"> 1. Fill 2. Test and analyze 3. Remove | As required | <ol style="list-style-type: none"> 1. Handling device(s) for 55-gal. drums and or case lot stock 2. Hand-regulating drain faucets dispensers for each type of P.O.L. |
| | (As required.) | <ol style="list-style-type: none"> 1. Bulk storage containers. 2. Piping. 3. Fill pipes and valves. 4. Pumps. 5. Equipment for collection and/or analysis of product. |

| requirements | criteria |
|--|--|
| <ol style="list-style-type: none"> 1. Enclosure for shop stock, POL, and paint should be located at a safe distance from maintenance facility, but still hold a relationship to the facility. 2. Area is to be secured. 3. Covered. 4. Spillage containment. | <ol style="list-style-type: none"> 1. Enclosure-type based on regulations applicable to flammable storage. 2. Locked enclosure or fenced (6 ft. high with access gate for vehicles) if enclosure has open sides. 3. Protected out of weather. 4. Berms for largest unit volume within the enclosure. |
| <ol style="list-style-type: none"> 1. Adequately sized bulk storage containers. 2. Underground. 3. Fill pipe must be in a location that does not interfere with shop activities. | <ol style="list-style-type: none"> 1. "X" cubic volume based on organizational unit requirements (reference Assumption 1). 2. Meet regulations for hazardous materials storage. 3. "X" distance from major activity centers. |

guidance

- i. Determine the total volumes of specific POL products required to perform a routine maintenance in accordance with schedules or practices.

a. Example

- (1) Total number of each vehicle type.
Ex. four, 1/4-ton Jeeps.
three, 2 1/2-ton trucks.
- (2) Type(s) of POL product used in each vehicle type.
- (3) Quantity of POL product used in each vehicle type.
- (4) Frequency of use of POL product for each vehicle type determined from SOPs, TMs, etc.
- (5) Consider other factors, i.e., POL product additions, ordering and delivery time, convenience, etc.

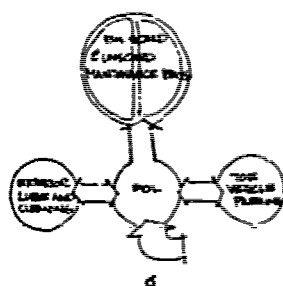
| (6) | Vehicle Type | Total No. of Vehicles | Product Type | Capacity | Frequency of Use | Other |
|-----|--------------|-----------------------|--------------|----------|------------------|--------------------|
| Ex: | 1/4-ton Jeep | 4 | m | 5 qt. | Quarterly | 1 qt./mo. addition |
| | | | | | | |

Summation:

- (7) Four, 1/4-ton Jeeps x 5 qt. oil type m = 20 qt. oil type m
 $20 \text{ qt. oil type m/vehicle} \times 4 \text{ times/yr} = 80 \text{ qt. oil type m/veh/yr}$
 $1 \text{ qt. oil type m/veh/mo} \times 12 = 12 \text{ qt./oil type m/veh/yr}$
 $12 \text{ qt. oil type m/veh/yr} \times 4 \text{ veh} = 48 \text{ qt. oil type m/veh}$
 $80 \text{ qt. oil type m/veh/yr} + 48 \text{ qt.} = 128 \text{ qt. oil type m per yr.}$
- (8) Repeat procedure for each vehicle type.

1. Determine type, quantity, and frequency of use for each product to be stored. (Reference assumption 1.)
2. Determine type of products to be stored in bulk based on factors in item 1.
3. Determine cubic volume of storage area needed for each product.
4. Determine products used infrequently for storage in drums or small containers.

guidance



FACILITY RECOMMENDATIONS. TOE Vehicle Parking and Internal Circulation

BACKGROUND: As an authorized exterior hardstand, TOE parking and internal circulation areas are the largest single improved part of a maintenance facility. TM 4-500-1 provides 75 sq. yd. of parking per organizational vehicle or 50 sq. yd. if the majority of vehicles are less than 18 ft. long and 6 1/2 ft. wide. The TM does not address the physical requirements of the vehicle or its parking requirements. Some servicing operations that are now performed on the hardstands result in storm water petroleum pollution.

RECOMMENDATIONS: For total area the following should be summed for each vehicle type, then multiplied by the number of each type assigned to the facility user:

- a. Physical vehicle dimensions
- b. Maneuver area requirements
- c. Loading/unloading area or minor maintenance area, whichever is larger
- d. Major dry maintenance area (track changing, etc.)
- e. Non-motorized vehicle/vehicle equipment storage area.
- f. Servicing storage area

A common area should be added to include stormwater collection/treatment and unit integrity.

IMPLICATIONS FOR THE FACILITY: Parking area requirements based upon a summation of the physical spaces (3-dimensional), as vehicles and users encompass all dimensions) required for each vehicle the user is authorized (and common areas applicable to the total facility) should be consistent with the vehicle needs so that significantly neither more nor less hardstand is provided. Some covered hardstand area for certain servicing operations would prevent stormwater sewer system petroleum pollution.

BENEFITS: Proper sizing to facilitate the usages of the parking area would promote less vehicle movement, reducing fuel consumption and increasing personnel safety. Advanced planning of the stormwater collection system by utilizing covered parking areas with contaminant separation would enable treatment systems to be added for compliance with standards as required by regulatory agencies.

function

TOE Vehicle Parking and Internal Circulation

policy

Exterior hardstand for TOE vehicle parking is authorized and, as such, is the largest single improved area at a maintenance facility

OM-23
TOE VEHICLE PARKING

issues and assumptions

1. Determination of vehicle parking area size:
Calculations for determining parking area and internal circulation based on individual vehicle space requirements will result in adequate area for storage and circulation of vehicles within the parking area. (It is possible that "standard" parking configurations and areas could be developed for company-level organizations.) Parking area for non-motorized vehicles such as trailers, etc., must also be provided.

- Advanced Practice 1: A stormwater collection treatment system will:
- a. Provide compliance with discharge standards required by regulatory agencies.
 - b. Require numerous treatment systems.

- Advanced Practice 2: Covered parking areas will:
- a. Prevent stormwater contamination by POL products and solids from the parking surface.
 - b. Minimize pollution control costs associated with collection and treatment of stormwater.
 - c. Provide protection from the elements to personnel working in the parking area.

activities

1. Vehicle maneuvering
2. Vehicle storage
3. Loading and unloading equipment
4. Minor maintenance
5. Gun cleaning

personnel

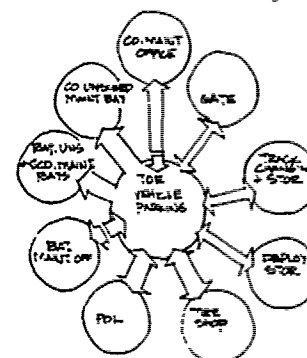
vehicle crew members

equipment

| requirements | criteria |
|--|---|
| <ol style="list-style-type: none"> 1. Adequate area for organizational vehicle parking and internal circulation. 2. Parking area should be securable from unauthorized entry and exit of vehicles. 3. Surface to withstand track vehicle usage if appropriate. 4. Provide adequate lighting. | <ol style="list-style-type: none"> 1. General criteria dependent upon TOE. 2. Fencing will consist of 7-ft.-high chain link fabric plus 3-strand barbed wire anti-climber. 3. Concrete to withstand 40 ton distributed load. 4. 5 f.c. at parking surface (adequate for pulling minor maintenance.) |
| <ol style="list-style-type: none"> 1. Sloped surface to drainage system. | <ol style="list-style-type: none"> 1. Slopes should be no greater than 2 percent. |

guidance

1. One large uninterrupted area is desirable.
2. Compute parking area as follows:
 - a. Determine vehicle types (including trailers and normal off-loaded equipment, i.e., AVLBs), numbers, and dimensions from TOE and TM documentation or references.
 - b. Determine maneuverability limitations for each vehicle type, i.e., turning radius and clearances required for gun tubes, etc.
 - c. Consider possible parking configurations on the basis of company or "unit integrity."
 - d. Determine aisle widths and vehicle clearance requirements based on items a and b above.
 - e. Other TOE vehicle parking areas and circulation considerations must be based on user requirements. Other parking areas include those required in the vicinity of the maintenance building for vehicles serviced, awaiting service, or upon which service has been interrupted. Circulation considerations include movement to and from exits and maintenance building.



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function

Check Personnel and Vehicle Entry and Exit at the Maintenance Complex
Dispatching and Keeping Operation Records of Unit Vehicles

policy

To enhance security and control use of TOE vehicles, a sentry and dispatch office is normally provided, either in combination at the complex entry, or in a maintenance facility interior space for a sentry when this function is done from Battalion common-use bays.

OM-24
SENTRY/DISPATCH

Issues and assumptions

1. Adequate area for activities:

An analysis of the functions of a sentry/dispatch or sentry office would dictate area requirements. Determine the requirements for records storage, access, sign-in (-out) sheets, etc. It also would appear desirable to develop a standard design for a sentry/dispatch and sentry offices; perhaps an industrialized building could be used.

2. Comprehensive extent of activities that occur:

The sentry/dispatch office will control exit and entry of vehicles and pedestrians from the complex area. Such control will require good visibility of pedestrian and vehicular traffic approaching the control point both for exit and entry. Additionally, night operation of the control point will require exterior lighting of the entry areas. Such lighting would be necessary for proper control by the sentry.

3. Location of dispatcher if at the maintenance facility:

The dispatcher can be located on the second floor with other administrative functions. This will allow more space on the ground floor for tool and supply storage. Where greater weight loads may occur, there will be better utilization of space within the building (should be near exit, preferably with view of TOE parking and maintenance bays).

4. Space allocation:

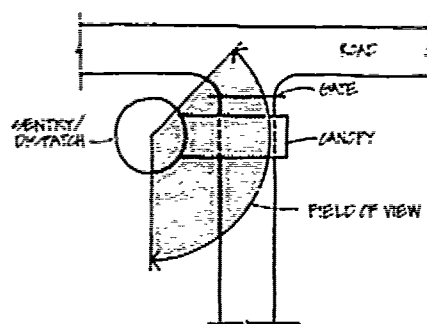
The space allocated for sentry/dispatch should be based on the number of people who will use the space and the size and amount of equipment that will be located there.

| activities | personnel | equipment |
|-------------------------------------|-------------------|--|
| 1. Recordkeeping | 1. 1 Sentry | 1. 1 X Desks with chairs |
| a. Process requests for vehicles | 2. 1 Dispatcher's | 2. File 4-drawer |
| b. Records mileage of vehicles. | | 3. Table for communication equipment 30 in. x 60 in. |
| c. Record problems with vehicles. | | 4. Locked cabinet 10 in. x 40 in. x 60 in. high |
| 2. ID checks. | | 5. Chalkboard 6 ft. x 4 ft. |
| 3. Forms, pass, etc., distribution. | | 6. Tack board 5 ft. x 4 ft. |
| | | 7. Cabinet 14 in. x 16 in. x 30 in. high |

| requirements | criteria |
|--|--|
| 1. Adequate office space. | 1. 80 to 90 sq. ft. per person in accordance with DOD 427D.1M. |
| 2. Illumination (interior and exterior). | 2. 60 f.c. (fluorescent fixtures) interior. Exterior illumination level will comply with latest edition of the IES Handbook for security control points handling vehicles and pedestrians. |
| 3. Power. | 3. A minimum of one duplex receptacle per wall. Coordinate additional requirements with the using service. |
| 4. Communication. | 4. Telephone (possible radio contact with remote vehicles required also). |
| 5. Environmental control. | 5. Winter 68°F., summer 78°F.D.B., where air conditioning is authorized by DOD 427D.1M; 65° F.W.B.; and 50 percent minimum RH. Ventilation - 10 CFM per person. |
| 6. Covered area at sentry post. | 6. (See guidance.) |

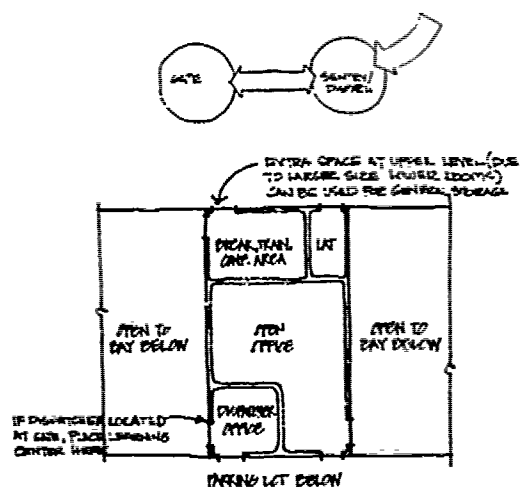
guidance

1. Normally locate office at the gate toward the barracks complex.
2. Good view of approaching pedestrian and vehicular traffic through windows.



guidance

1. Should be near exit, preferably with view of outside parking area and bays.



NOTE: CORNER OFFICE LOCATION FACILITATES VISUAL ACCESS TO BAYS AND PARKING

SECOND FLOOR DISPATCHER OFFICE

function

Deployment of equipment Storage

policy

Current deployment policy requires that deployment equipment storage be provided in Company-sized units, since Companies generally act independently when deployed.

OM-25
DEPLOYMENT STORAGE

Issues and assumptions

1. Determination of storage area required:

If storage area is based solely on the size of the gross building area, rather than using Company-specific requirements, adequate space will probably not be assigned to many units. Also, if storage area is addressed from a two-dimensional standpoint, rather than as three dimensions, the user requirements will probably not be fulfilled.

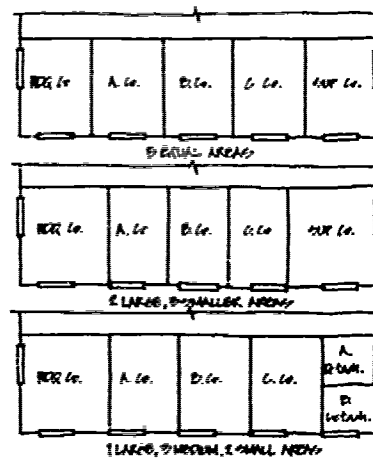
It is therefore recommended that calculations for determining deployment equipment storage based on using Company requirements will result in adequate storage capacities. (It is possible that "standard" storage configurations and size could be developed for Company-level organizations.)

| activities | personnel | equipment |
|--|-------------------------|---|
| 1. Placement and retrieval of equipment in storage | 1 Using Order personnel | Dr. vehicle Materiel, JMW, and O. Sust. Issue Items, etc. |
| 2. Maintenance of equipment while stored | 1 Same as active | |

| requirements | criteria |
|---|---|
| 1. Space should be provided for the using Company's required equipment. | 1. Determine from using Company's TGE list the area of each item requiring deployment storage. |
| 2. Access space should be provided for the using Company's required equipment placement/retrieval and maintenance operations. | 2. Determine individual equipment handling and maintenance characteristics. |
| 3. Storage must be secured by the using Company. | 3. A locked caged area with Company level key control. Partitioning to be flexible (See guidance sketches.) |
| 4. Illumination. | 4. 20 f.c. fluorescent fixtures. |
| 5. Power. | 5. 110V in duplex outlets on perimeter walls. |
| 6. Environmental control. | 6. 60°F. winter. |

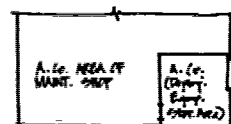
guidance

- Deployment equipment storage could be integral with the maintenance building to minimize the duplication of equipment and structure required to fulfill the technical requirements applicable to this type of storage.
- Using Company access should take precedence over convenience to other Companies' areas.



THREE CONFIGURATIONS OF DEPLOYMENT STORAGE REQUIREMENTS RESULTING IN NEED FOR FLEXIBILITY IN THE LOCATION

DEPLOYMENT STORAGE CENTRALIZED FOR ENTIRE BATTALION FOR FLEXIBILITY



DEPLOYMENT STORAGE DIRECTLY RELATED TO CO. AND/OR FOR READY ACCESS BY CO. PERSONNEL

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function

POV Parking and Internal Movement

policy

Current policy allows POV parking areas in the vicinity of TDE maintenance complexes.

OM-26
POV PARKING

issues and assumptions

1. Determination of POW parking requirements:

The factors for parking area allocations based on a percentage of personnel assigned to the facility to be served are not described in sufficient detail. Use of this method may result in too little or too much space allocated for POW parking.

It is suggested that installation-specific factors such as the following be considered when determining POW parking requirements:

- a. Availability of mass transit systems
- b. Car pooling requirements.
- c. Availability and authorization of off-post and on-post housing (family and troop housing).
- d. Actual number of personnel assigned within the maintenance complex.
- e. Visitor spaces.

Other factors warranting consideration are:

- a. Personnel drop zones for arriving and departing personnel using POWs or mass transit systems.
- b. Area security, including illumination and area inclosures.

activities

personnel

equipment

| requirements | criteria |
|---|---|
| 1. Area for safe parking and maneuvering of vehicles. | 1. Allocate approx. 35 sq. yd. of paving per vehicle, based on assigned personnel, adjusted by the factors listed under "Issues and Assumptions." |
| 2. Security entrance and exit. | 2. 12-ft., double-hung, locked gates. |
| 3. Adequate lighting. | 3. 5-ft. C, based on security lighting specifications. |
| 4. Paved parking surface. | 4. Bituminous surface. |
| 5. Parking space should be adequately identified. | 5. 2-in. line, nonsoluble paint. |
| 6. Curbs and gutter to drainage. | 6. 6-in. concrete. |
| 7. Stormwater drainage system. | 7. - |

| guidance |
|---|
| 1. Locate parking area so that it provides convenient access to facility. |
| 2. Determine parking area based on user requirements. |
| 3. Provide fence or equivalent protective enclosure for a secure parking area. |
| 4. Provide drop zone area near the facility entrance gate. |
| 5. Pedestrian crosswalk is required if parking area is located across a street. |

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function

Administration of Maintenance Operations

policy

Administrative tasks for supply and equipment control are required independently in Company support sections.

SM-1
SUPPORT OFFICES

Issues and assumptions

1. Location of administrative areas:

All administrative spaces are located contiguous with the spaces they support.

2. Extent of reference manuals:

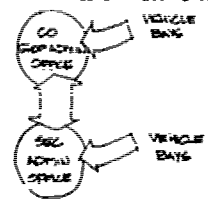
Each Company and Section needs a reference library for deployment.

Advanced Practice 1:

Computerized work flow and management.

| activities | personnel | equipment |
|---------------------------------|---|--|
| 1. Supervision/control. | Admin. office (ASL) (8 to 13 people) (4 to 5 w/1 need desks). | Microfiche viewer. Microfiche library. Desks with chairs. File--4-drawer. 6 ft. Counter, Customer Service. |
| 2. Recordkeeping | | |
| 3. Job order processing. | DS shop office (3 to 4 people) | Desks with chairs. File--4-drawer. Production control board. |
| 4. Library of reference manuals | Quality control office (5 to 6 people). | Desks with chairs. File--4-drawer. Ref. library shelves. |
| | Automotive section (3 people). | Desks with chairs. File--4-drawer. Ref. library shelves. |
| | Armament office (2 to 3 people). | Desks with chairs. File--4-drawer. Ref. library shelves. |
| | Eng. equip. office (2 to 3 people). | Desks with chairs. File--4-drawer. Ref. library shelves. |
| | Service office (2 to 3 people). | Desks with chairs. File--4-drawer. Ref. library shelves. |
| | | Note: all desks 60 in. x 35 in., amount varies with number of specific personnel assigned. |
| | | Remote terminals hook up into centralized system. |

| requirements | criteria |
|-----------------------------------|---|
| 1. Adequate space. | 1. 80 to 90 sq. ft. per person, with additional space for equipment and files. |
| 2. Power. | 2. 110V duplex outlets each 10 feet from wall. |
| 3. Lighting. | 3. 50 f.c. with fluorescent fixtures. |
| 4. Heating, cooling, ventilation. | 4. Winter: 68°F; Summer: 78° F.D.B. where air conditioning is authorized by DOD 4270.1M; 65° F.W.B.; 50 percent minimum R.H. ventilation - 10 CFM per person. |
| 5. Communication. | 5. Telephone (intercom needs vary with the specific shops). |

| guidance |
|--|
| <p>1. The supervisory personnel must be able to observe the work areas (bays). Preferably, the administration office space should be located on the second floor with windows in all walls.</p>  <p>The DS Section office space will be separate from the administration offices and located near their respective shop, bay, and/or van.</p> |

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function

Support Level Communications and Electronic Equipment Maintenance

policy

SM-2
COMME FIRE CONTROL

Issues and assumptions

1. Equipment location:
Equipment for COMREL operations at the Support level are provided for in a van.

activities

1. Receive COMTEL equipment from shop office (store backlog).
2. Equipment is inspected, tested, and repaired.
3. Return to shop office for delivery to customer or returned for Dx.

| personnel |
|----------------------------|
| 1 platoon of approx 20. |
| 1-Officer 1-NCOIC |

equipment

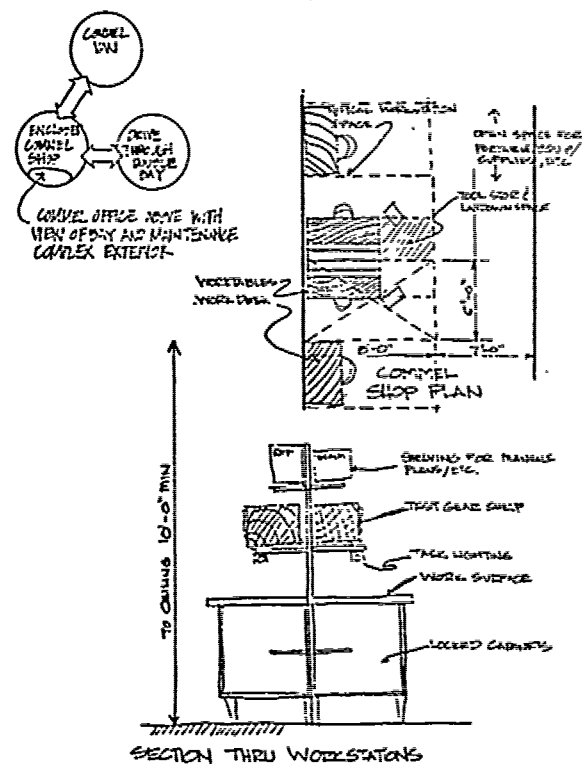
1. Electronic work bench (60 in. x 30 in.) with stool, each work station
2. Desk (48 in. x 30 in.) with chair, each work station
3. Shelving over bench for publications (5 lin. ft.) each work station.
4. Shelving (12 to 18 in. deep) for storing COMTEL equipment (20 lin. ft.)
5. File cabinet - 2-drawer.
6. Safe file - 4-drawer.
7. External roof-mounted antenna.

1. 2 desks (60 in. x 30 in.) with chairs.
2. 2 side chairs.
3. File cabinet - 5-drawer.
4. Safe file - 5-drawer.

| requirements | criteria |
|---|---|
| 1. Office area for officer and NCOIC. | 1. Approx. 20L sq. ft. |
| 2. Inclosed shop area for test, storage and repair. | 2. - |
| a. Adequate space. | a. Approx. 80 sq. ft. per work station, with additional 42 sq. ft. per person for open multi-use space. (See guidance.) |
| b. Illumination. | b. 50 f.c. ambient light, with supplemental task lighting to 120 f.c. |
| c. Power. | c. 110V - (4 duplex outlets at each work bench). 24V (DC) special power. |
| d. Lockable doors. | d. 3 lock security system. |
| e. Antenna connection for COMEL work station. | e. - |

guidance

1. Should be convenient to drive through double bay.
2. Should be convenient to parking area.
3. Dusty environments should be avoided.



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FACILITY RECOMMENDATIONS: Support Maintenance Shop Vans

BACKGROUND: Direct support vans are provided to supply mobile shop capability to forward organizational units when deployed. The design of direct support maintenance complexes should reflect this tactical requirement.

RECOMMENDATIONS: Direct support maintenance complexes should be designed on the basis that the support van will be an integral yet detachable part of the maintenance complex. This can be achieved by providing a loading dock opening onto one or more work bays within the complex. Support equipment would be stored and utilized on the van while support work is being performed in the shop bays.

IMPLICATIONS FOR THE FACILITY: Mobility aspects of direct support maintenance should be considered in the design of the maintenance complex.

BENEFITS: The primary benefits to be derived from making the support van an integral but detachable part of the support maintenance complex are (1) the simulation of conditions that will be experienced under deployment and (2) building economies realized through deleting the space requirements of the equipment provided in the support vans.

function

housing and transporting (for Deployment) Mobile Maintenance Equipment

policy

**SM-3
VAN**

issues and assumptions

Required tools and other equipment are kept on vans for deployment. Therefore, while in garrison, some provision must be made for locating the vans near the bays or other spaces they serve if the Support unit is to function efficiently.

activities

Activities will vary with van function.

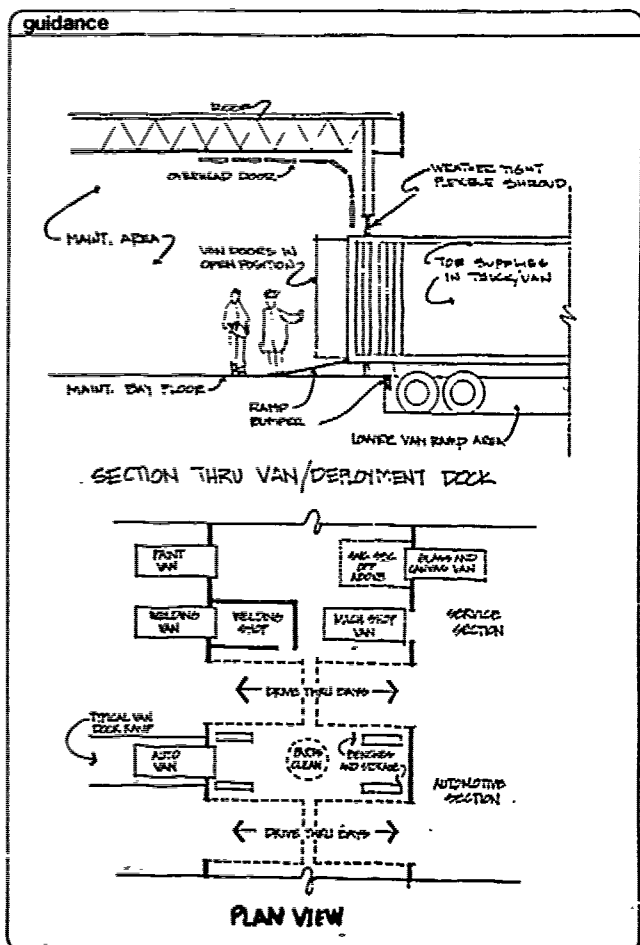
personnel

(varies).

equipment

(varies).

| requirements | criteria |
|---|--------------------|
| 1. Special connector for power supply to van from building. | 1. 110v. |
| 2. Compressed air connector or flexible line. | 2. - |
| 3. Docking area to provide entrance to the van from the maintenance facility at floor level, plus weather-tight dockage hookup. | 3. (See guidance.) |



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function

Performing Maintenance on Evacuated TOE Organizational Equipment

policy

Direct support maintenance bays are needed to perform more sophisticated and specialized vehicle and equipment repair than that normally performed in organizational units.

SM-4
SUPPORT LEVEL BAYS

Issues and assumptions

1. Support Maintenance Capabilities:

Each GS line company is assumed to have within it the following sections: O&MEL, Automotive, Armament, Engineer Service and possibly Missile Maintenance.

Armament is further broken down into:

Fire Control, Turret/Artillery, Small Arms Repair, and possibly Missile Maintenance.

activities

1. Inspect for PM compliance.
2. Component replacement (with limited component repair).
3. Replace gun tubes painting, welding, etc., and other duties as assigned. (vary with Section).

personnel

Variable.

equipment

- (See Unscheduled Maintenance Bay (M2) and Service Pits (M2).)
1. Allow parts cleaning capability for automotive and engineering.
 2. Need a minimum of 2 engine stands for automotive.
 3. Retractable drop lights in bay.
 4. Retractable power cords in bay.

requirements

criteria

| ORGANIZATION | PITS | | | | | | | | | | |
|--------------|-----------|-----------|---------------|-------------|-------------|-------|-----|--------------|-------------|----------|-------|
| | TOT. REQ. | HEAVY PIT | WASTE HOLDING | UNDER FLOOR | ANTI FREEZE | WATER | AIR | 10 GPM/ MIN. | TEMP. FLOOR | SEAL PIT | SEWER |
| PAUL CONT. | 4 | 4 | | | | | • | | | | |
| AUTOMOTIVE | 4 | 4 | • | • | • | • | • | • | • | • | • |
| ENR. EQUIP. | 2 | 2 | • | • | • | • | • | • | • | • | • |
| APPROXIMATE | | | | | | | | | | | |
| TURKEY/PIR | 2 | 2 | • | • | | • | • | • | | • | • |
| MISSILE | 2 | 2 | • | • | | | • | | | | • |
| SERVICE : | | | | | | | | | | | |
| WELDING | 1 | 1 | | | | • | • | | | | |
| PAINT & PT. | 2 | 2 | | | | | • | | | | |

The requirements and accompanying criteria for these spaces are essentially the same as indicated for: Unscheduled Maintenance Bay OM2
Service Pits OM3
Small Parts Cleaning OM8

The following table lists quantities of service pits and utility connections required.

guidance

Similar to guidance for: OM2 Unscheduled Maintenance Bay
OM3 Service Pits
OM8 Small Parts Cleaning

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function

Receive, Store, and Issue Repair Parts/Shop Stock for Customers
and Support Sections

policy

DS SHOP STOCK SM-5
ASL BULK STORAGE ASL CUSTOMER SERVICE

issues and assumptions

Parts Delivery

All repair parts that will include shop stock are received for issue/storage by ASL/Tech Supply.

ASL/Tech Supply

Requests, receives, stores, and issues all repair parts and shop stock for customers, including the support maintenance sections.

Sections

Request and receive job order repair parts and store for daily use shop stock.

Customer

TOE units that are designated as support maintenance customers submit requests and receive organizational repair parts.

ASL Bulk Storage

Exterior, secured, restricted access storage area for bulk repair parts/components.

ASL Vans

Support maintenance organizes vans for repair parts storage (ASL) for issue to customers.

activities

1. Parts flow

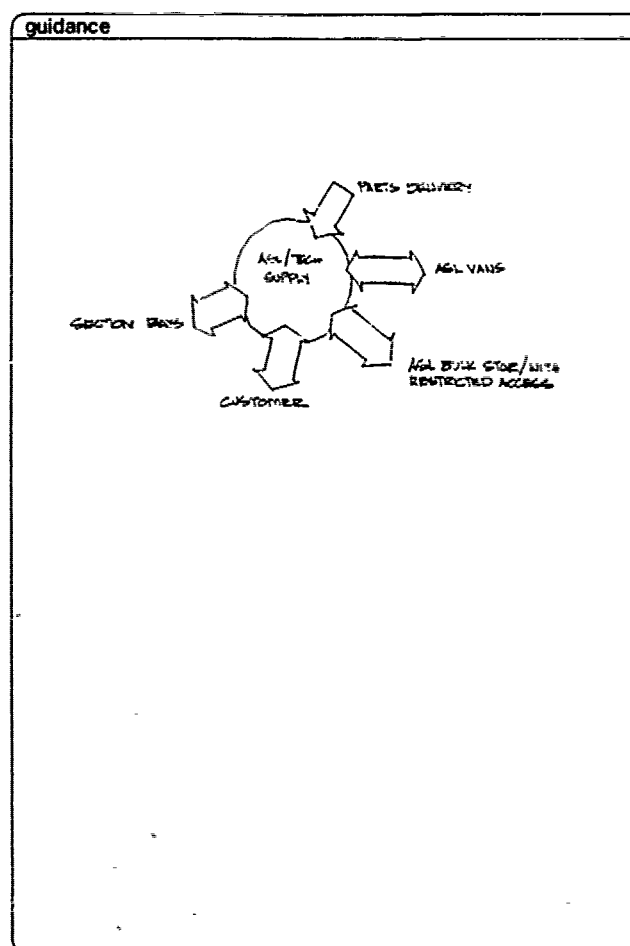
personnel

1. ASL/Tech supply officer.
2. 8 to 10 other personnel

equipment

1. Small parts bins
2. Counter
3. Microfilm viewer
4. Microfilm library
5. Desks with chairs
6. File cabinet
7. Visible file cabinet
8. Reference library
9. Space/equipment needed in section areas
 - a. Space for lazy Susan type revolving bins.

| requirements | criteria |
|--------------------------------|----------|
| 1. Adequate space. | 1. - |
| 2. General office ventilation. | 2. - |
| 3. General lic'cing. | 3. - |
| 4. See SM 1. | 4. - |



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function

To Provide Parking and On/Off Loading Area for Evacuation and Vehicle Transport Equipment

policy

Evacuation and tank transport to DS is required for specialized DS services. A parking and on/off loading area is required for vehicle storage.

SM-6
EVAC & TANK TSP EXTERIOR AREA

issues and assumptions

1. The in-garrison practice of vehicle evacuation and tank transport occurring at the organizational level results in a loss of time and efficiency. A considerable amount of time is spent in loading, transporting, and unloading vehicles. This activity may occur several times if, following inspection, quality control personnel operating within the support maintenance complex discern that organizational maintenance on the vehicle has been inadequate. Thus a large parking and on/off loading area for vehicles waiting to be serviced and transient vehicles is required.

If support maintenance combat team type maintenance procedures were used at all times, the time spent for evacuation and tank transport and the space required for storing these vehicles could be substantially reduced. A majority of support service would be conducted within the organizational maintenance area via van deployment. Any vehicles requiring in-house support services would be evacuated and transported by the support unit. Thus, since a majority of support maintenance would be performed at the organizational complex, the amount of space required for loading, unloading and parking for vehicles could be reduced.

2. Consider vehicle parking by vehicle type rather than by organizational unit to reduce space requirements.
3. Other parking areas should be considered: awaiting parts, awaiting shop, awaiting pick-up, and float vehicles. Also customer parking.
4. See TOE parking, advanced practice (covered parking/wastewater treatment).

activities

1. Retrieve tactical equipment requiring support maintenance either in the shops or as part of CX

personnel

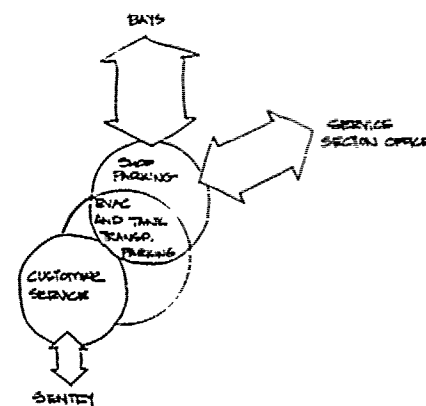
equipment

2 to 3 tank transporters (12 ton).

| requirements | criteria |
|--|--|
| 1. Sufficient space for loading/unloading, parking and circulation. | 1. Area required for each tank transporter in operation based on tractor, trailer, and vehicle dimensions. |
| 2. Stormwater collection. | 2. - |
| 3. Security lighting. | 3. - |
| 4. Fenced area with lockable gate. | 4. - |
| 5. Hard surface. | 5. Concrete. |
| 6. Covered. | 6. - |
| 7. Size parking and circulation area based on installation size, vehicle types, and past support records of vehicle servicing. | 7. - |

guidance

Area to be provided within vehicle parking (wait shop sub-category) for off-loading. Parking of evacuation and transport equipment to be provided for either in DS function parking area or organizational unit parking area. Consider other parking requirements for vehicles awaiting parts, awaiting the shop, awaiting pick-up, customer parking and float vehicles.



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function

Storing Tools and Specialized Test Equipment used by Quality Control Personnel

policy

SM-7
TOOL & TEST EQUIP. STORAGE

Issues and assumptions

Quality control tool and test equipment storage and personnel should be located in the same area.

activities

1. Tool storage.
2. Test equipment storage.
3. Movement of tools and equipment in and out of storage.

personnel

1. 5 to 6 personnel

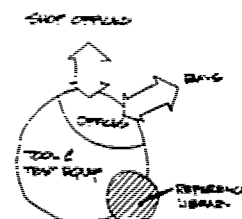
equipment

1. Shelving (amount varies with UIC)
2. Battery tester
3. Timing equipment.
4. Electrical testing equipment.
5. Desks (60 in. x 30 in.) and chairs, for at least 4 personnel
6. 4-drawer file.

| requirements | criteria |
|--|------------------------------------|
| 1. Adequate work station area. | 1. Approx. 80 sq. ft./person. |
| 2. Sufficient space for tool/test equipment storage. | 2. Approx. 100 sq. ft. |
| 3. Illumination. | 3. 60 f.c. (fluorescent fixtures). |
| 4. Environmental control. | 4. 68°F. winter. |
| 5. Secured. | 5. Locked doors. |

guidance

1. Convenient access to shop offices and to bays.
2. Circulation area for both personnel and equipment movement.



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FACILITY RECOMMENDATIONS: Painting Bay(s) in Support Maintenance Facilities

BACKGROUND: "Painting bays are not authorized in organizational maintenance units." (OG 1110-3-80) Spray painting of vehicles is typically a general support function; spot painting is authorized at the direct support maintenance level. "Painting bays may be provided from the vehicle bay allocation by separating them from other bays. . . ." (OG-1110-3-80).

RECOMMENDATIONS: Provide a painting bay(s) in the body and paint area of support maintenance complexes which will satisfy the painting requirement and meet personnel health and safety requirements.

IMPLICATIONS FOR THE FACILITY: A defined painting bay(s) in the body and paint area would be equipped to fulfill the facility painting requirement.

BENEFITS:

- (1) Confine the painting operation to a specified area of the maintenance facility.
- (2) Provide greater personnel and facility efficiency.
- (3) Improve personnel safety requirements.
- (4) Minimize pollution potential of the facility from solvents and paints.

function

Vehicle Painting: to perform vehicle or vehicular component painting at the support level

policy

Currently, vehicle spot painting is authorized at the Direct Support maintenance level. Whole vehicle painting is done at the General Support level.

SM-8
PAINT BAY

issues and assumptions

1. Location for required vehicle painting:

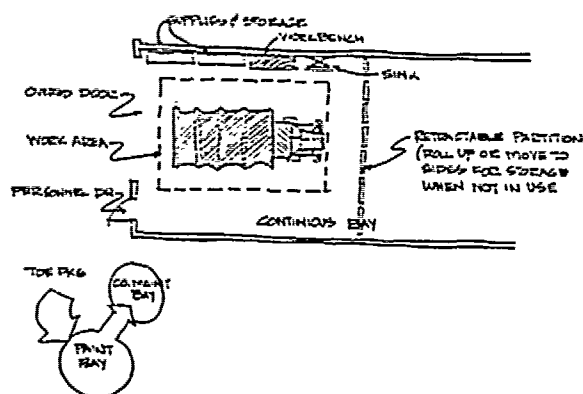
1. No painting is authorized at the organization level. Painting is authorized at the support level, either DS or GS. Equipment for painting at the DS level is maintained on a van.
2. If a defined area was allocated for painting at the battalion level, worker health could be protected from mist, explosive and flammable hazards could be minimized, and overspray could be better controlled.

| activities | personnel | equipment |
|--|-------------------|---|
| <ol style="list-style-type: none"> 1. Prepare surface. 2. Paint. | <p>1 painter.</p> | <ol style="list-style-type: none"> 1. Compressor and paint sprayer. 2. Workbench (3 ft. x 6 ft.). 3. Solvent and waste containers. <p>(equipment for painting is maintained on vans)</p> |

| requirements | criteria |
|---|---|
| 1. Adequate space, as part of a drive-through double bay. | 1. Approx. 24 feet x 32 feet. |
| 2. Overhead vehicle door. | 2. 15 feet x 18 feet. |
| 3. Electrical service. | 3. 110V. |
| 4. Compressed air. | 4. - |
| 5. Good task lighting. | 5. 100 to 150 f.c. (for specific areas of a vehicle while being painted). |
| 6. Ventilation with exhaust. | 6. Neg. air pressure through an exhaust system. |
| 7. Fire extinguisher. | 7. - |
| 8. Service sink. | 8. Cold water. |
| 9. Bay separation. | 9. Noncombustible partition meeting OSHA and NFPA requirements. |

guidance

1. Partial to full enclosure is necessary to control fumes and external dust.



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Summary of Specific Recommendations

On the following pages, Table 3-1 summarizes the recommendations for improved Army Maintenance facilities by functional space name and indicates the significant benefits of each. Most of these specific recommendations require higher level action before they can be implemented at the installation level. Since current practice is controlled by existing regulations, Department of the Army (DA) and Major Commands (MACOM's) must concur with the recommendations and revise and update the current regulatory documents and/or policies.

The benefits have been grouped into four general categories:

Pollution Abatement: more precise control and metering of petroleum dispensing, spillage, waste and disposal. Better "up front" planning and control will preclude the necessity of some pollution control and abatement systems. By changing some maintenance practices and the location of storm water drains, pollutants will not get into the storm systems; thus abatement and control will be easier and more cost effective.

Energy Conservation: a reduction in the energy needs and consumption. Changes in maintenance practices and the facilities themselves will reduce the amount of times the doors have to be open and the extra equipment required to move "down" vehicles. Savings on petroleum products will be realized through the implementation of practices such as bulk POL storage and the oil monitoring system.

Personnel Effectiveness: more efficient and effective use of the maintenance personnel. Through adequate facilities and advanced practices the Scheduled Maintenance can be performed properly and significantly reduce the amount of Unscheduled Maintenance. The floors and pits will be easier to keep clean and, therefore, much safer. With the low reenlistment rates in the maintenance MOS's (about 16%), improved facilities are expected to impact reenlistments by providing garrison maintenance facilities comparable to civilian shops. Any increase in the reenlistment of E1's to E4's will provide candidates for promotion to E5's and E6's -- the much needed supervisory personnel.

Construction Economy: a cost savings in the areas of both retrofitting and maintenance costs for the facility. Proper planning will assure that all facility requirements are met before any construction is started. Retrofit costs are more than double the initial construction costs and must be minimized. Facility maintenance costs will also be minimized through the use of these recommendations. Clogged drains, for example, will be prevented if there is minimal oil spillage and parts cleaning in the bays. Also, the use of more cubic feet of interior building space can be obtained by placing office spaces on a second level.

Table 3-1 Summary of Facility Improvement Recommendations

| space | RECOMMENDATIONS | benefits | | | |
|---|--|------------------------|------------------------|----------------------------|-------------------------|
| | | pollution abatement | energy conservation | personnel effectiveness | construction economy |
| om1,2 Maintenance Bays | Allocation and facility capability based upon <u>scheduled</u> and unscheduled maintenance requirements. | ● | ● | ● | |
| om3 Service Pits | Install full service pit(s) capable of handling tracked and wheeled vehicles. | ● | ● | ● | |
| om5 Tire Shop | Dedicate a space for tire repair with appropriate equipment for safe, efficient working conditions. | | | ● | |
| om6 Welding Shop/Bay | Provide space, necessary safety equipment, and associated support features. | | | ● | |
| om8 Parts Cleaning | Provide commercial small parts cleaning equipment capable of recycling solvent until spent. | ● | ● | ● | |
| om11 Exterior Vehicle Lubrication and Cleaning Area | Provide exterior maintenance bays as retrofit items to existing shops experiencing certain conditions. | ● | ● | ● | |
| om12 Track and Gun Area | Dedicate a specific exterior area for track storage, changing, and gun sight calibration. | | | ● | |
| om13,14 Vehicle Washing | Provide centralized wash facilities with wastewater treatment and optional water recycling systems. | ● | ● | ● | ● |
| om15 Maintenance Office | Position supervisory and administrative office spaces on the second floor of maintenance facilities. | | | ● | ● |

| space | RECOMMENDATIONS | benefits | | | |
|-------------------------------|--|------------------------|------------------------|----------------------------|-------------------------|
| | | pollution abatement | energy conservation | personnel effectiveness | construction economy |
| om17 Tool Control | Establish adequate storage space including carts for tool boxes, bench stock and the like for all units at maintenance facilities. | | | ● | ● |
| om18 DX/PLL | Co-locate "full-time" PLL clerks with a computerized inventory system. | | | ● | ● |
| om19 Classroom/ Break Area | Establish a break/training room in each maintenance facility for group training. | | ● | ● | |
| om20 Learning Center | Establish a learning center in each maintenance facility for individual training. | | | ● | |
| om21 Latrine | Install water-saving devices in all water-use fixtures. | ● | ● | | |
| om22 POL Storage | Incorporate bulk storage and dispensing systems in all maintenance facilities for POL and other commonly used products. | ● | ● | ● | |
| om23 TOE Vehicle Parking | A new method for determining the total area needed at a maintenance facility for parking, storm water collection/treatment and the like. | ● | ● | ● | ● |
| sm3 Vans | Design Support maintenance complexes so that support vans will be an integral yet detached part of the complex. | | | ● | ● |
| sm8 Body & Paint Bays | Provide space for painting activities at support facilities. | ● | | ● | |

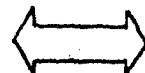
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4

4 SPACE RELATIONSHIPS AND FACILITY SYSTEMS

This chapter shows (1) how a maintenance facility is organized to effectively support facility operations, and (2) briefly describes various systems necessary for distributing utilities and supplies and for collecting wastes.

LEGEND FOR CHAPTER 4 FIGURES



required adjacency



visual access



direct outdoor access

Facility Space Relationships

Relationships among spaces are discussed for three levels: the site, the maintenance building itself, and logical groups of spaces within the building.

1. Site Relationships.

(a) For Organizational Maintenance, Figure 4-1 shows the relationships among the shop building and spaces exterior to it. Access to the site must be via Sentry/Dispatch at the gate. Other exterior spaces include parking for TOE vehicles, POL storage, and storage of deployment equipment and supplies. Figure 4-2 shows general circulation for vehicle movement on a site.

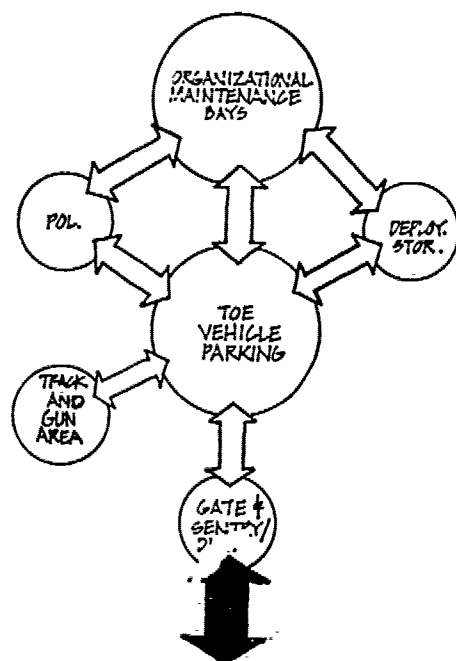


Figure 4-1 OM Site Relationships

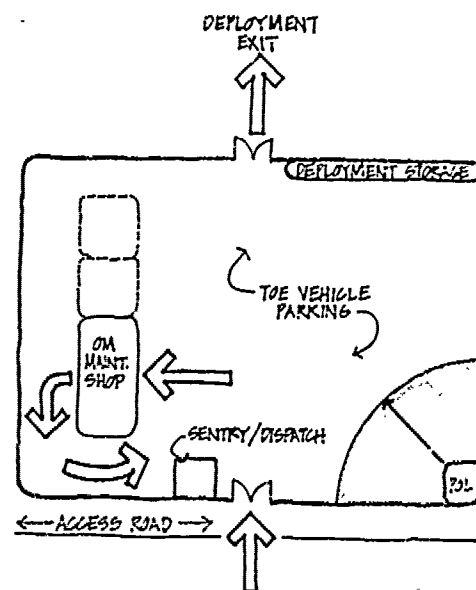


Figure 4-2 OM Site Circulation

(b) For Direct Support (DS) Maintenance, Figure 4-3 shows relationships among the shop and spaces exterior to it. DS units have an organizational maintenance function. The DS and organizational functions should be adjacent and interconnected. Figure 4-4 shows the vehicle circulation on a DS maintenance site. Considerable traffic volume is generated as organizations supported by the DS organization bring vehicles or components onto the site.

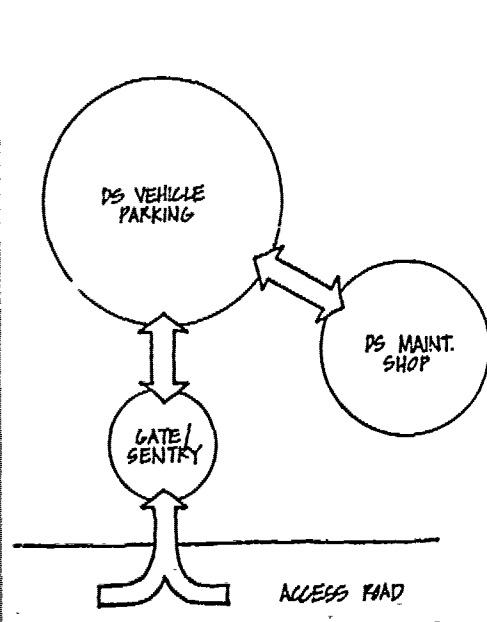


Figure 4-3 DS Site Relationships

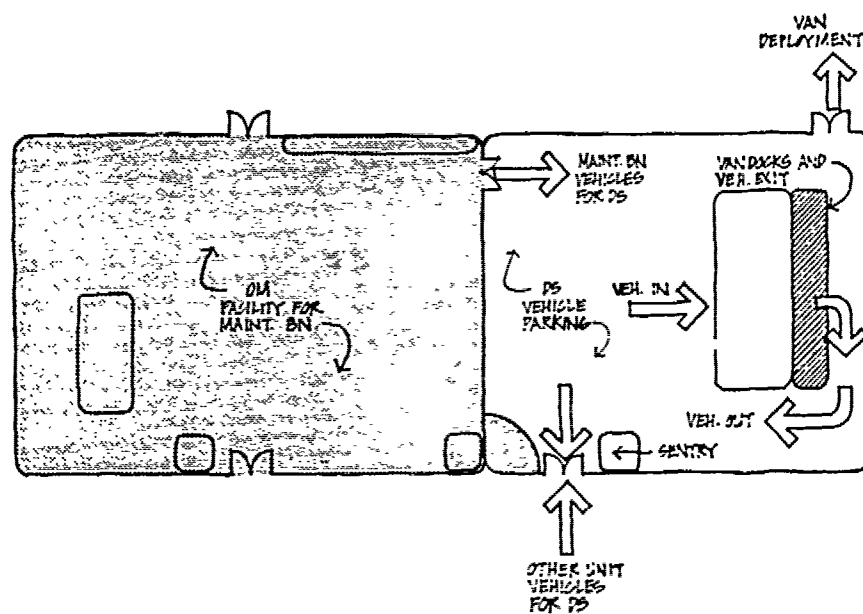


Figure 4-4 DS Site Circulation

2. Maintenance Building Space Relationships.

The relationships among spaces within the maintenance shop are important to the support of the operations housed. Figure 4-5 shows the relationships for organizational maintenance. Similarly, Figure 4-6 shows the relationships among organizations in a DS maintenance shop.

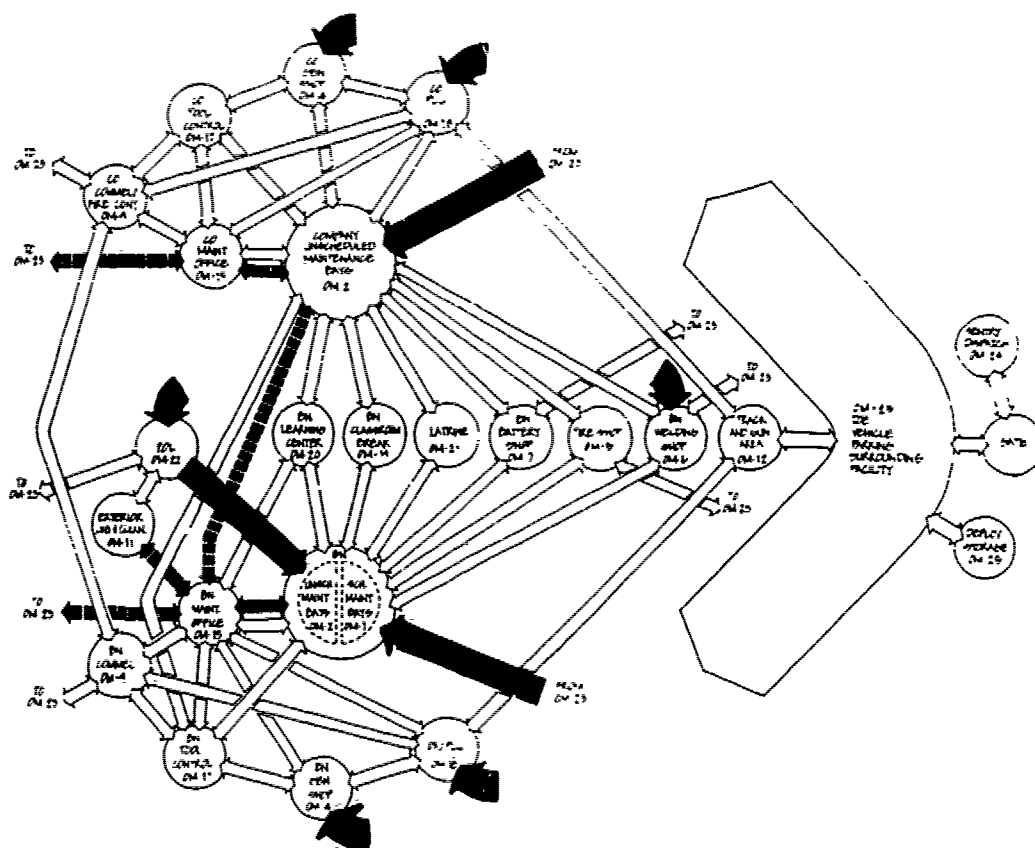


Figure 4-5 OM Facility Space Relationships

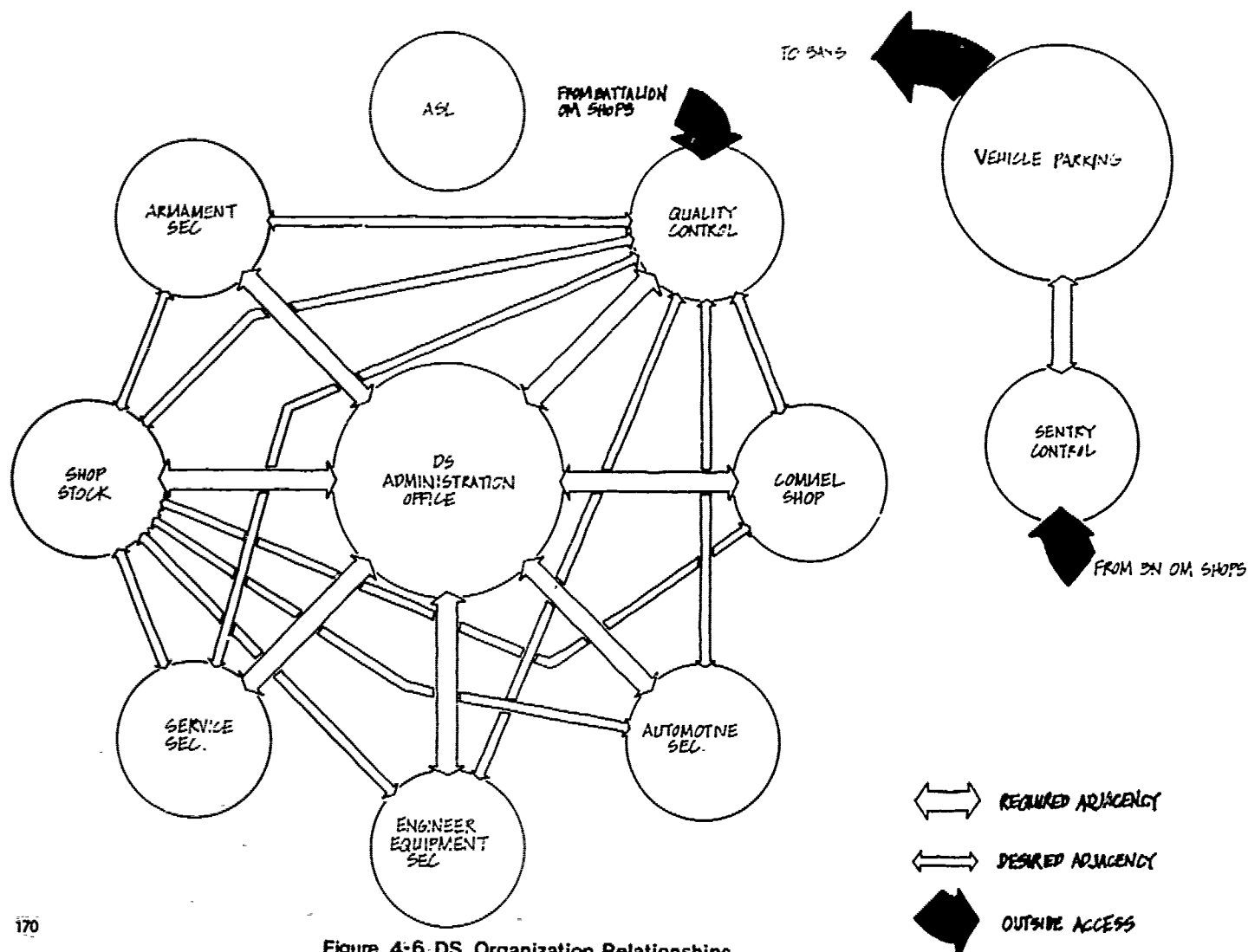


Figure 4-6 DS Organization Relationships

3. Functional Modules.

There are several organizational units within any maintenance shop. In many cases, several functions within these units should be organized around the unit, rather than grouping similar activities from different units.

(a) In Organizational Maintenance, there are several Companies in a Battalion shop. Because first-level supervision, responsibility, recordkeeping, and reporting are Company activities, efficient Company performance depends on locating its activities in the same area. This results in a Company module, with each Company's activities separated and the group of separate activities clustered together. Figure 4-7 shows the relationship among spaces supporting company activities.

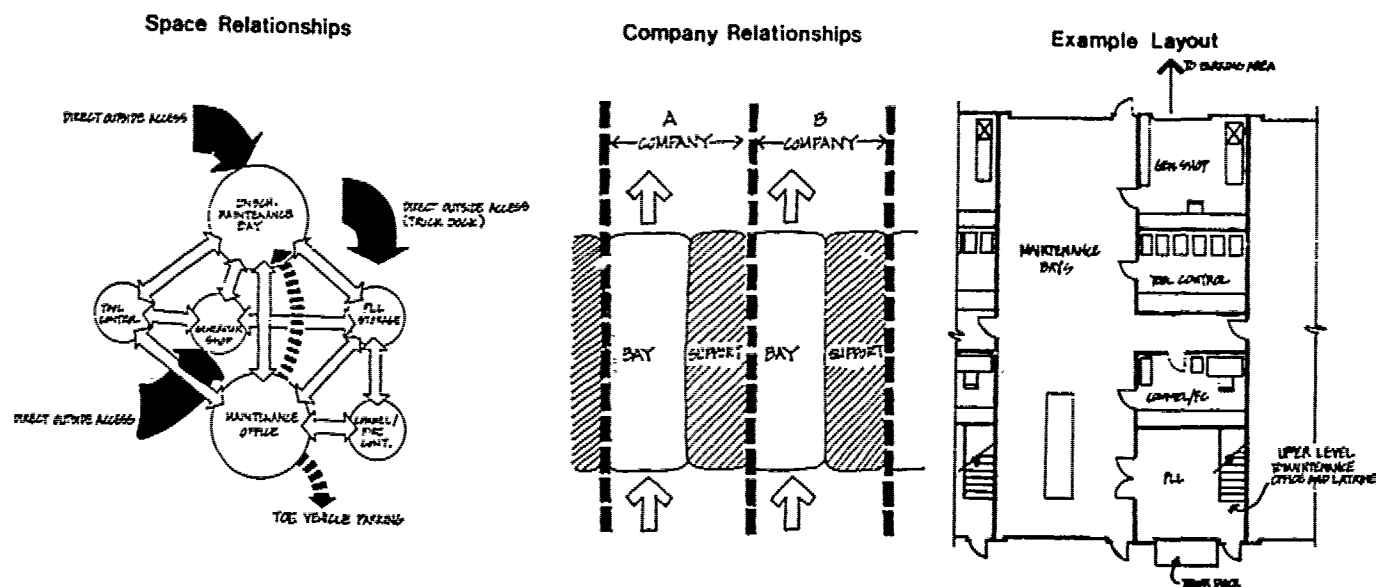


Figure 4-7 OM Company Module

(b) There are several Sections within each DS maintenance Battalion or Company. Company activities should be grouped together, and spaces for each Section should be functionally related so that Section activities can be performed effectively. Functional modules or clusters are required for the following Sections: DS office, automotive, engineering equipment, armament, service, quality control, and authorized supply list (ASL). Figures 4-8 through 4-14, respectively, show these modules and the relationships among the spaces within the modules for each Section. Table 4-1 shows the space types required for each DS Section.

| SUPPORT MAINTENANCE BATTALION | | | | |
|-------------------------------|------------|-----------------|---------------------------|-------|
| Support Company | | | DS Shop Office | SM-1 |
| | | | DS Shop Stock | SM-5 |
| | Compl | | Compl Shop | SM-2 |
| | Automotive | | Auto Bays (4) | SM-4 |
| | | | Auto Office | SM-1 |
| | | | Auto Van | SM-3 |
| | Engr Eqpt | | EE Bays (2) | SM-4 |
| | | | EE Office | SM-1 |
| | | | EE Van | SM-3 |
| | Armament | Fire Cont | Armt Office | SM-1 |
| | | | FC Shop | SM-2 |
| | | | FC Van | SM-3 |
| | | Turret/Arty | T/A Bays (2) | SM-4 |
| | | | T/A Van | SM-3 |
| | | Small Arms Rpr | SAR Van | SM-3 |
| | | Missile Maint | MM Bays (2) | SM-4 |
| | | | MM Van | SM-3 |
| | Service | | Service Sec Office | SM-1 |
| | | Mach Shop | MS Van | SM-3 |
| | | Weld Shop | WS Bays (2) | OM-6 |
| | | | WS Van | SM-3 |
| | | Body & Paint | BP Bays (2) | SM-8 |
| | | | BP Van | SM-3 |
| | | Canvas & Glass | CG Van | SM-3 |
| | | Evac & Tank Tsp | ET Exterior | SM-6 |
| Quality Control (QC) | | | Office | SM-1 |
| | | | QC Bays (2) | SM-4 |
| | | | QC Tool & Test Equip Stor | SM-7 |
| Authorized Supply List (ASL) | | | ASL Office | SM-1 |
| | | | ASL Cust Svc | SM-5 |
| | | | ASL Vans (up to 12) | SM-3 |
| | | | ASL Bulk Storage | SM-5 |
| (Distributed Facility Spaces) | | | Parts Cleaning | OM-8 |
| | | | Service Pits | OM-3 |
| | | | Maintenance Supply Area | OM-16 |

Table 4-1 Space Types by DS Section

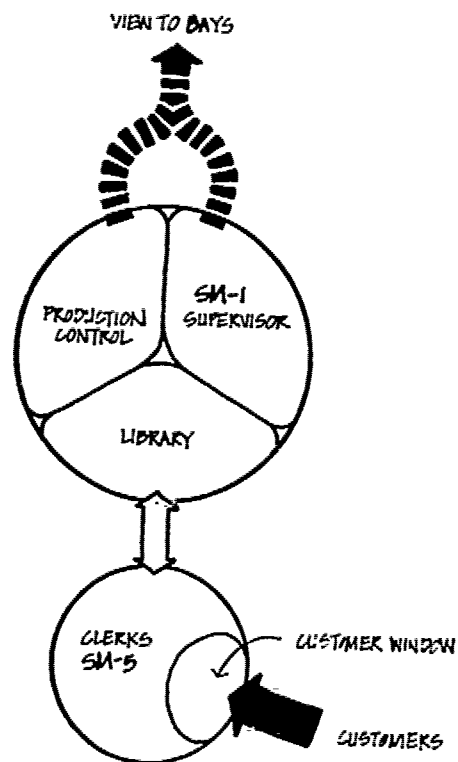


Figure 4-8 DS Shop Spaces

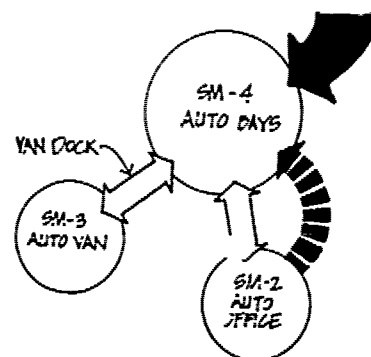


Figure 4-9 DS Co Automotive Sec Spaces

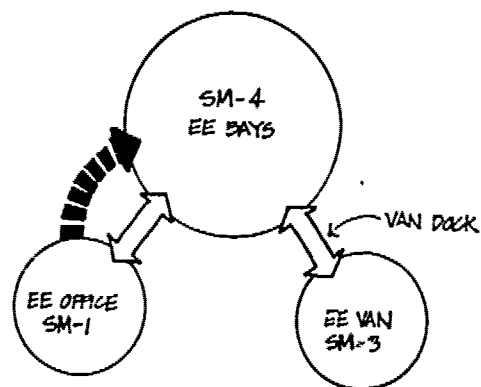


Figure 4-10 DS Co Engr Eqmt Sec Spaces

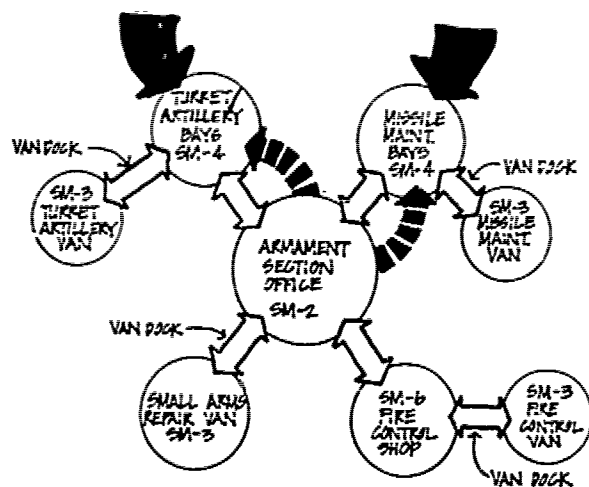


Figure 4-11 DS Co Armament Sec Spaces

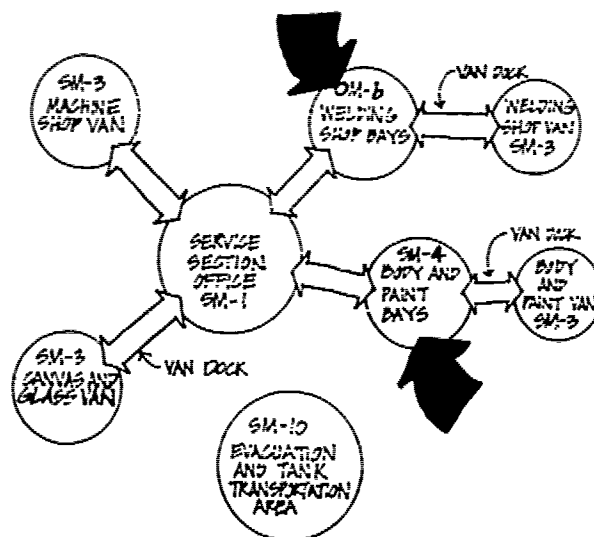


Figure 4-12 DS Co Service Sec Spaces

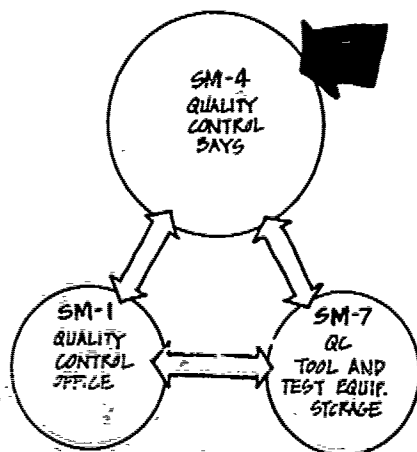


Figure 4-13 DS Co Quality Control Spaces

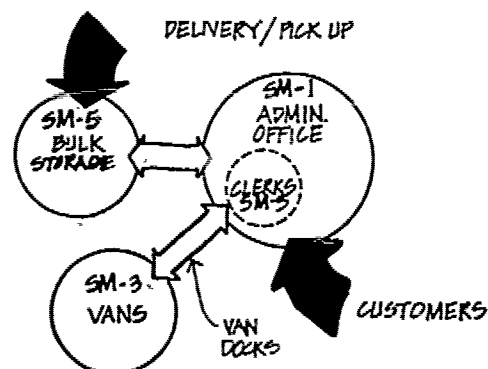


Figure 4-14 DS Co ASL Spaces

Facility Systems

A variety of support systems must be provided and built into maintenance buildings to insure that maintenance operations are effective and that all equipment is operational. The following subsections describe the more significant systems; a schematic diagram or table is provided for each system to show its location to and function within the shop.

1. Electrical System

It is assumed that electrical service will be distributed throughout an organizational maintenance shop. Table 4-2 summarizes the electronic requirements, including task or special lighting, i.e., other than general lighting and requirements for 110V, 220V, and 24V DC power. The table also lists the equipment serviced by these voltages.

| Space No. | Space Name | 110V | 220V | 24V DC | Type of Equipment Supported | Lighting Task | Lighting Special |
|-----------|--------------------------------|------|------|--------|---------------------------------------|---------------|------------------|
| 1. | Scheduled Maint. Bay | | | | Exhaust | | |
| 2. | Unscheduled Maint. Bay | • | • | | Tools, Crane, Exhaust | | • |
| 3. | Fits | • | | | Tools, Trouble Light, Pumps, Exhaust | • | • |
| 4. | Generator Shop | • | | | Tools | | • |
| 5. | Tire Shop | • | | | Tools | • | |
| 6. | Welding Shop & Bay | • | • | | Tire Machine | | |
| 7. | Battery Shop | • | | | Tools, Lights, Future Welder, Exhaust | • | |
| 8. | Parts Cleaning | • | | | Battery Charger | | • |
| 9. | Control/Fire Control | • | | | Cleaning Stand, Pump | • | |
| 10. | Parashute Shop | • | | • | Test Instr., Control | • | |
| 11. | Exterior Lub and Cleaning Area | | | | | • | |
| 12. | Maintenance Office | • | | | | | |
| 13. | Tool Control | | | | | | |
| 14. | 57/Fil | • | | | Microfiche Reader | | |
| 15. | Classroom/Break Area | • | | | Vending, A-V Equip | | • |
| 16. | Learning Center | • | | | | | |
| 17. | Latrine | • | | | | | |
| 18. | POL Storage | | | | | | |
| 19. | 10E Vehicle Parking | • | | | Tools | | • |
| 20. | Sentry/Dispatch | • | | | | | |
| 21. | Deployment Storage | • | | | | | |
| 22. | POL Parking | | | | | | |
| | Building Exterior | | | | | | |
| | Building Mechanical | | | | | | • |

Table 4-2 Electrical System

2. Exterior Lighting

Exterior lighting is provided near the maintenance building for selected maintenance activities, safe maneuvering of vehicles, and building security. Exterior electrical outlets will allow use of supplemental lighting fixtures, such as "trouble" lights or floodlights.

Exterior lighting in the Sentry/Dispatch, or gate area, will insure both the safety and control of vehicle entry and exit to the maintenance complex.

Lighting in the TOE and POV parking areas will provide for increased vehicle security, safe pedestrian and vehicle movement, and convenient deployment and return of vehicles after sunset. Lighting in the TOE parking area having 110V outlets increases the utility of the parking area by allowing convenient use of supplemental lighting for loading and unloading operations, minor maintenance, inspection, and other activities.

3. Ventilation

Some spaces used for vehicle maintenance activities have special ventilation requirements to control air contaminants. Table 4-3 summarizes the spaces and their ventilation requirements. Table 4-3 does not list ventilation requirements for thermal comfort or for purposes other than contaminant control.

| Space No. | Space | Ventilation Rate | Room Pressure | Contaminant | Remarks |
|----------------------|---|---|---------------|----------------------------------|--|
| OM-1 OM-2 OM-4 | Scheduled Maint. Bay Unsched. Maint. Bay Generator Shop | | | Engine exhaust | Exhaust ventilation required for health and safety to remove CO and other combustion products. |
| OM-3 | Pits | 12 air changes per hour | | Engine exhaust, flammable vapors | Exhaust ventilation required for health and safety to remove vapors which settle to low points and possibly reach toxic or explosive concentrations. |
| OM-6 | Welding Shop | If bay is confined and (a) is less than 10,000 cu ft. or (b) has less than a 10-ft ceiling, or (c) natural cross-ventilation is not provided, a general ventilation system is required with 2000 CFM per welder. If local exhaust hood with 3-inch flange is provided, 100 FPM air flow must be provided in the welding zone. | | Toxic fumes | Exhaust ventilation required to remove hazardous fumes from welding. |
| OM-8 | Parts Cleaning | | | Flammable vapors | Exhaust ventilation required to remove vapors from immersion tank and main floor. |
| OM-9 | COMEL/Fire Control Shop | | Positive | Dust | Work in this shop involves cleaning of electronic and optical equipment. Dusty air should be avoided. |
| OM-21 | Latrine | | Negative | Odor | Ventilation air should be exhausted. |
| OM-10 | Parachute Shop | | | | |

Table 4-3 Special Ventilation Requirements

A compressed-air system is required in the building to provide high-pressure air for operating pneumatic tools and special equipment and for cleaning parts. The system, shown schematically in Figure 4-15, has a centralized compressor, distribution lines, and terminal points at various locations in the building. Chapter 3 provides further information on compressed-air requirements at specific locations.



5. Water Supply

Potable water will normally be supplied to the maintenance complex to be used for all water requirements. Special activities or equipment may require water-conditioning equipment within the maintenance building, i.e., battery makeup water may require better quality than provided by the available potable water, and steam cleaning and boiler(s) equipment may require further "conditioning" of the potable water supply. Available plumbing guidance should be consulted when designing the water supply system. Recently enacted legislation requires that Federal facilities investigate recycle and reuse techniques prior to construction of wastewater treatment facilities. This legislation encourages Federal facilities to incorporate reuse/recycle in their water and wastewater management schemes. Consequently, nonpotable internal and external reuse/recycle strategies may become more common at DA posts in the future.

Reuse/recycle will decrease potable water supply demands and will decrease effluent flows from sewage treatment plants. Guidance in this area is being developed at CERL.

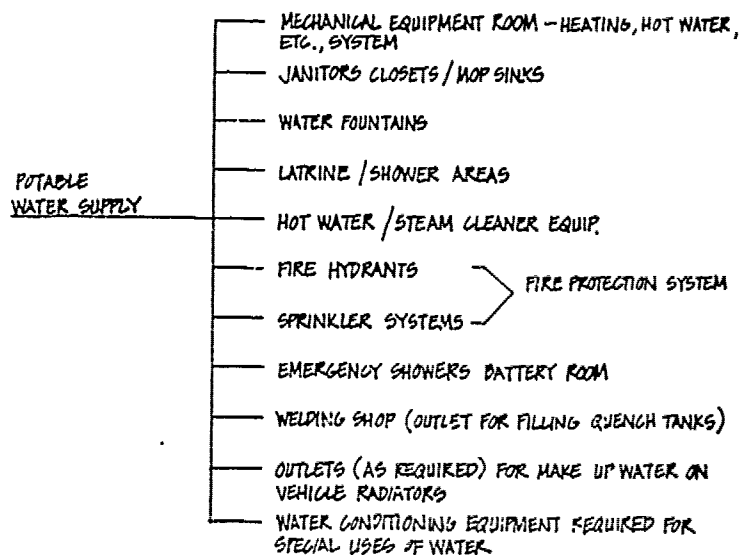


Figure 4-16 Water Supply System

6. Oil Separation-Wastewater System

Wastewater and oil will become mixed as a result of various activities associated with vehicle maintenance. Discharge of wastewaters containing substantial concentrations of grease and oils to sanitary systems can cause substantial problems in sewers and at the treatment plant. Separation of oil-bearing wastewater from other wastewater streams also provides economical pretreatment for removing oil and sediment. (Sediment will originate in cleaning operations.) Convenient removal of separated oil and sediment from the separation system must be built into the pretreatment device. Adequately pretreated wastewaters may be discharged into most sanitary systems.

Pollution control was a major consideration in the development of many of the concepts presented in Chapter 3. Preventive and minimization measures for water pollution have been considered in the various options or alternatives presented for individual work spaces. Qualitative assessment of the wastewaters from a total maintenance complex cannot be made until an actual physical layout of functional areas and general activity descriptions for these areas have been generally determined and described. Then, a qualitative, and in some instances, a quantitative description of wastewater collection and (pre)treatment systems can be made by experienced personnel.

Some individual components described in Chapter 3 are *isolated* sources of wastewaters. An example is a centralized vehicle exterior wash area. This area is a common use area shared by all organizations on an installation. There would be one, or possibly two, areas provided for each installation. Assuming that only *exterior* washing occurs at these locations, wastewaters generated would most often be treated for suspended solids, greases and oils, and dissolved organics. The wastewater treatment system would be an integral portion of the centralized wash area system. Gravity separation of suspended solids and free oils and greases would be accomplished in a large basin appropriately equipped for convenient removal of settled solids and floating free oils and greases. The basin could be followed by intermittent sand filtration or other systems for polishing wastewater prior to discharge or possible recycle. Selected installations may determine that it is possible to use stormwater for washing vehicles at centralized wash areas; this would be dependent on rainfall, water demands, and other physical site considerations.

Assumed Conditions

1. Centralized tactical vehicle wash facilities are available for the exterior and interior personnel area for washing of equipment returning from field exercises.
2. New maintenance facilities will be provided with scheduled and unscheduled maintenance bays, fluid dispensing systems, and other advanced practices. Therefore, standard exterior grease racks and washracks are not included as part of the TOE maintenance plan.
3. Existing TOE maintenance complexes will be retrofitted with exterior maintenance platforms (existing washracks abandoned) and improved grease racks if building modifications cannot provide for all maintenance operations to be performed indoors.

| Facility Space | (1) Water Pollutant Concentrations | | | | | | | | | |
|--|-------------------------------------|---|--|--|--|--------------------------------------|--------------------------------------|--|--|--------------------------------|
| | Suspended Solids | Oils Free | Emulsified | Solvents Soluble | Insoluble | pH | Heavy Metals | Biodegradable Soluble | Insoluble | Remarks |
| Scheduled Maintenance Bays: Fit Floor Drains Bay Floor Drains Waste Oil Collection System Power Pak and Hull Cleaning Area | Variable Variable Low High | Low Low - High | Low Low - High | Low Low - Variable | Low Low - Variable | Normal Normal - Variable | Normal Normal - Normal | Low Variable - Variable | Low Low - Low | No Water |
| Unscheduled Maintenance Bays: Fit Floor Drains Bay Floor Drains | Variable Variable | Low Low | Low Low | Low Low | Low Low | Normal Normal | Normal Normal | Low Low | Low Low | |
| Battery Shop: | High | Negligible | Negligible | Low | Low | Acid | High | Low | Low | Special Drain |
| Mechanical Room: | Variable | Low | Low | Low | Low | Variable | Variable | Low | Low | High Dissolved Solids Possible |
| Parts Cleaning Areas: Waste Solvent Collection System | High | | | | | | | | | No Water Solvent System |
| Tire Repair Area Floor Drains: | Low | Low | Negligible | Negligible | Negligible | Normal | Normal | Low | Negligible | |
| Welding Area Floor Drains: | Low | | | | | | | | | |
| Stormwater: Parking Roadways Roofing PG Storage Area | Variable Variable Low Low | Variable Low Negligible Variable | Negligible Negligible Negligible Negligible | Negligible Negligible Negligible Variable | Negligible Negligible Negligible Variable | Normal Normal Normal Normal | Normal Normal Normal Normal | Negligible Negligible Negligible Negligible | Negligible Negligible Negligible Negligible | |
| Generator Shop: Waste Oil Collection System Floor Drains | Low Variable | - Low | - Low | Negligible Negligible | Negligible Negligible | - Normal | Normal Normal | Negligible Negligible | Negligible Negligible | No Water |

(1) Water systems have been assumed; waste oil and solvent collection systems are special cases. Contaminants of concern have been individual for the No-Water wastes.

Table 4-4 Pollutants within a Maintenance Complex

The system described above will likely be appropriate for many installations; actual planning for the necessary wastewater treatment system would follow sizing of wash facility and assessment and estimation of anticipated wastewater flows and character.

A tracked vehicle maintenance platform as described in Chapter 3 will produce wastewaters of an estimable quality and quantity, if equipped and used as described. Assuming sufficient capacity and appropriate treatment mode in the sanitary treatment plant, pretreatment of wastes from such an area could make wastewaters adaptable to "polishing" in the sanitary system. It is further assumed that there is sufficient capacity in the sanitary sewer system to accommodate the flow and associated stormwater from such an area. The pretreatment would consist of gravity separation of free oil and grease and suspended solids in a basin equipped for convenient removal of separated oils and solids. Sizing and equipping of such a pretreatment system would depend on levels of usage anticipated, equipment provided, stormwater flow, and other physical factors specific to the location.

General guidance identifying pollutants of concern from various sources within a maintenance complex is provided in the following table. The assumptions regarding the maintenance complex area are stated in Table 4-4.

7. Sanitary Sewer Collection System

Two types of wastewaters will enter the sanitary sewer system: (1) those conventionally hooked into a sanitary system, e.g., from latrines, water fountains, and conventional building maintenance activities, and (2) those *pretreated* industrial wastewaters that have been determined to be compatible with installation sewer and treatment systems. "Pretreatment" may involve using actual treatment systems located within the maintenance complex, or providing occupant-oriented instructions concerning appropriate disposal techniques for wastes such as battery acid.

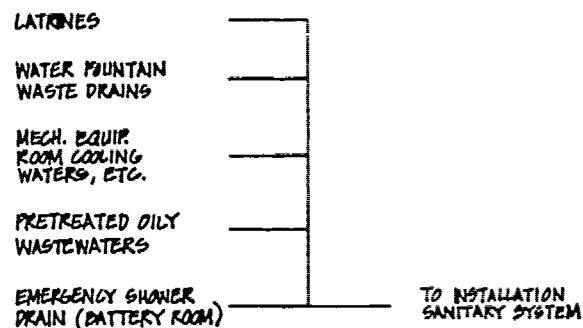


Figure 4-17 Sanitary Sewer System

Retrofitting Existing Maintenance Facilities

Changes in existing maintenance operations and retrofitting maintenance facilities can help installations meet water pollution control requirements. An added benefit from well-coordinated changes in facilities is greater personnel efficiency in maintenance practices. A common indicator of water pollution control problems from maintenance facilities is finding oil, detergents, or solvents in stormwater discharges. Vehicle washracks are commonly recognized as a source of water pollution control problems. Generally, the major functions in a tactical vehicle maintenance area which cause water pollution problems are: (See Table 4-4, page 179)

- 1) Cleaning operations. Includes vehicle exterior and interior washing, parts, work area, and major vehicle component (motors and gun tubes) cleaning. Some of these cleaning operations are most frequently accomplished at washracks with cold water, excessive cleaning aids (detergents, solvents and fuels), and substantial labor. The wastewater from these cleaning operations will almost always be found to discharge directly into stormwater systems, or to pass through poorly designed and ineffective "sediment basins/oil separators" built with washracks. Other cleaning operations such as "parts cleaning" will involve containers of solvents or fuels which, because of a lack of alternatives, will be dumped into stormwater drains or at the edge of a motor pool. Less frequently, discharges from cleaning operations will be found to be a cause of major problems in sanitary sewers or treatment plants which were not designed to accommodate either the volumes or the waste concentrations and character present in the industrial-like wastewater from tactical vehicle maintenance areas.
- 2) Oils and lubricants (POL) storage, transfer and handling operations. Most POL products are stored in exterior, unequipped, unlit, and uncovered areas. The most common storage container is the 55-gallon drum. For purposes of clearly describing this "source" of water pollution, consider changing crankcase oil only on an M-60 tank motor-pack. Maintenance personnel must drain approximately 17 gallons (130 pounds) of waste oil from the engine. This waste oil must then be disposed of using facilities and equipment which are either non-existent, or not designed to facilitate clean, efficient transfers from engine to waste oil storage containers. Replacement oil is frequently obtained from POL storage areas by tipping 55-gallon drums to fill 1-gallon containers which are used to convey oil from storage to engine. Maintenance personnel will make 17 transfers of new oil in servicing a single M-60 engine. Commonly, all of the above will occur in exterior hardstand areas such as that provided for washracks or parking. Current design guidance and recently constructed facilities do not address these pollution control inadequacies.

- 3) Storage, handling, and transfer equipment and facilities for other materiels required for vehicle operation and maintenance. Equipment and facilities for the numerous materiel's (non-POL) required in maintenance of the fleets of sophisticated, complex, and numerous vehicle types required by the Army generally are "makeshift" at best. Non-POL fluids (antifreeze, paints, synthetic hydraulic fluids), parts (protected from corrosion with oil or other preservatives), cleaning compounds, compressed gases, and other materiel must be stored, transferred, and used in a maintenance area. Specific examples of how activities generate water pollution control problems are as diverse as in the materiel's used. Generally, principles described in (2) above will apply.

Preventing water pollution through modification of the facilities, equipment, procedures, and operations using water, or exposed to stormwater, is the most economical way to achieve environmental goals related to vehicle maintenance. Treatment of the tremendous volumes of wastewater, and diverse character and concentrations of pollutants in wastewater from existing Army vehicle maintenance areas would require industrial waste treatment operations and processes which are complex, costly (capital and O&M), and energy and manpower intensive. The character of wastewaters from existing maintenance facilities has been found to require wastewater treatment facilities which could not be physically located where required because of space limitations within the cantonment area.

Information presented in Chapter 3 was developed as a means of preventing or minimizing pollution control problems associated with new maintenance facilities. Individual functional areas described in Chapter 3 also have application to modernization or retrofitting of existing facilities, and to those facilities in the various stages of the MCA construction cycle. The following functional areas described in Chapter 3 would likely have direct application to modernization either through new construction or extensive modification of existing facilities:

- 1) Interior Spaces:
 - Scheduled Maintenance Bay OM1
 - Unscheduled Maintenance Bay OM2
 - Parts Cleaning OM8
- 2) Exterior (Covered) Maintenance Spaces:
 - Tracked (Wheeled) Vehicle Maintenance Platform OM11
 - Centralized Wheeled Vehicle Washing OM13

Centralized Tracked Vehicle Washing

OM14

3) Exterior Support Spaces:

POL Storage OM22
TOE Vehicle Parking OM23

Actual design of wastewater treatment facilities is dependent upon specific information regarding volume, and on character and concentration of wastes. This information can be determined or estimated once a maintenance area conceptual plan is available.

Retrofitting maintenance facilities can include additive structures, installing new or revising existing building support systems, building alterations, and numerous other general categories of construction or equipment installation and modification. For purposes of this document, the process will be described through which a concept for improving facilities for a specific purpose within existing maintenance areas was developed.

Ft. Carson, Colorado, had indorsed and planned construction of a centralized exterior wash facility. Discussions between CERL engineers and occupants of maintenance areas (Motor Sergeants and Warrant Officers) were held to develop a concept of a facility which would accommodate activities being performed on existing motor pool washracks which could not be performed at centralized wash areas. The concept was adopted for incorporation with installation construction planning. The system developed was the "tracked vehicle" maintenance platform described in Chapter 3, OM11. This concept was taken from the "idea stage" to preliminary sketches and cost estimates. This idea has since been adopted by Ft. Stewart and Ft. Lewis as a means of modernizing their maintenance areas. The concept was modified to meet the unique requirements of TOE units at the new installations, and improved to accommodate more activities than previously anticipated at Ft. Carson.

The benefits of this retrofitting include: 1) various water pollution concerns from maintenance activities were minimized or eliminated, 2) maintenance personnel anticipate substantial improvement in personnel efficiency while performing the maintenance activities addressed by the facility, 3) POL products, new and used, will be handled in a much more efficient and effective manner, and 4) substantial capital and O&M costs for pollution control systems were avoided, or minimized.

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